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MOTORSHIP

In the Interests of Commercial Motor Vessels

Vol. 2 JUNE, 1917 No. 6

SEATTLE NEW YORK

MOTORSHIP "JUTLANDIA" PASSING THROUGH CULEBRA CUT, PANAMA CANAL

Published on the Twenty-fifth of the Month

MOTORSHIP

United States and Mexico, Per Year $3.00
Foreign Countries $3.50
Per Copy 25c

Vol. 2 SEATTLE, U. S. A., JUNE, 1917. No. 6

Government Shipbuilding Program

IN view of the confusion which has attended the formulation of plans for the government's shipbuilding program and the consequent conflicting reports which have appeared throughout the country, Motorship is pleased to be able to present to its readers in this issue an authoritative statement from the government covering all contracts which had been let up to the moment of going to press, together with delivery terms, general form of contracts and specifications. This statement is based upon official telegraphic advices:

UP to June 5th the Emergency Fleet Corporation, as the official government shipbuilding and operating company is called, had let the following contracts:

Merrill Stevens Company, Jacksonville, Fla., twelve wooden and four steel cargo ships complete. Deliveries: Steel, one in twelve months and one each succeeding month; wood, one in nine months and one each succeeding month.

Los Angeles Shipbuilding & Dry Dock Company, Long Beach, Cal., eight steel ships complete. Deliveries in pairs May, June, October and November, 1918.

G. M. Standifer Construction Corporation, Portland, Ore., ten wooden steamers complete. Deliveries in pairs eight, nine, ten, eleven and twelve months.

Peninsula Shipbuilding Company, Portland, Ore., four wooden steamers complete. Deliveries February, March, April and May, 1918.

Sloan Shipyards Corporation, Seattle, sixteen wooden steamers complete. Deliveries: Two January, two February, four March, two April, two May, two June, two July, 1918.

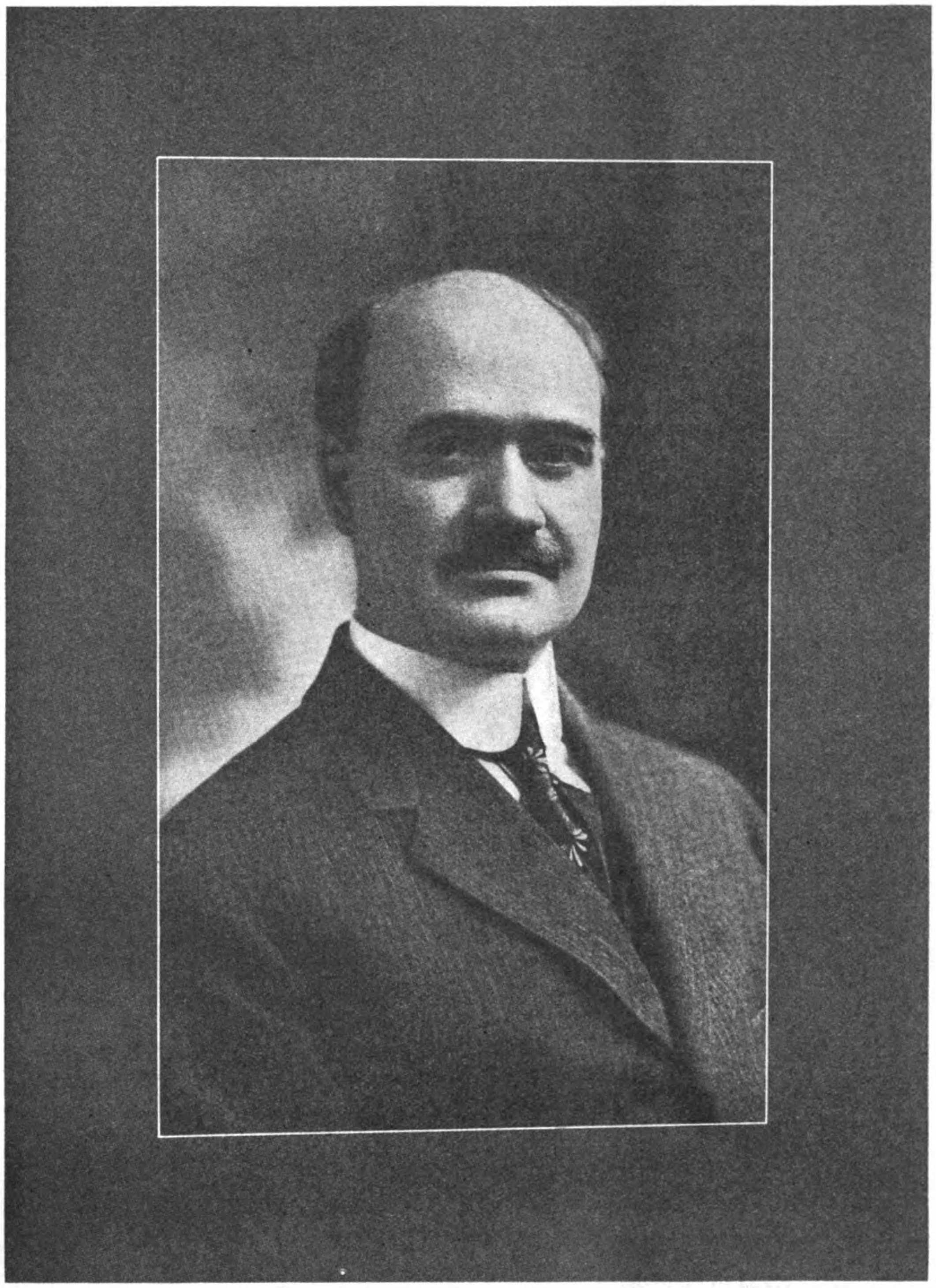
Grays Harbor Motorship Corporation, Aberdeen, Wn., four wooden hulls only. Deliveries: One January, one February, one March, one April, 1918.

Coast Shipbuilding Company, Portland, Ore., four wooden hulls. Deliveries: One January, one March, one May, one July, 1918.

Edward F. Terry and Henry L. Brittain, New York City, twenty composite steamers complete. Deliveries: One February, 1918; remainder in ten months thereafter.

Skinner & Eddy Corporation, Seattle, six steel steamships complete. Deliveries: Two within five months after date of arrival of keel plates, remaining four in pairs at intervals of approximately six months after completion of first two.

Total number of vessels contracted for to June 5, 88. Number of wooden vessels 50, composite 20, steel 18. Number allotted to Pacific Coast: Wooden 38, steel 14, total 52. Number allotted to Atlantic Coast: Wooden 12, steel 4, composite 20, total 36. Largest single contract, Brittain and Terry, New York, for composite vessels. Largest wooden contract, Sloan Shipyards Corporation, Seattle. Largest steel contract, Los Angeles Shipbuilding Co., Long Beach, Cal. Seattle received the largest allotment of any city in the United States, three firms there being awarded a total of 26 wood and steel vessels; New York being next, with 20 hulls, and Portland, Ore., third, with 18 wooden hulls.



THEODORE E. FERRIS, DESIGNER OF THE GOVERNMENT'S STANDARD WOODEN SHIPS

THE crowning achievement of a successful career as a naval architect came to Theodore E. Ferris when commissioned by the United States Shipping Board to design the vessels which will constitute the emergency fleet and also form the nucleus of an American mercantile marine.

Mr. Ferris in years past had the benefit of an excellent training under the late Carry Smith, to whom he returned and subsequently became a partner in Smith & Ferris after filling the position as chief draughtsman with Townsend & Downey, Shooters Island. Since the death of Carry Smith the firm has been known as Theo. E. Ferris, successor to Smith & Ferris. Prior to and since then many notable steel vessels have been designed, among his recent conspicuous efforts being "Panuca" Ward Line and "Cauto" New York and Cuba Mail Steamship Co., both constructed by the Seattle Construction & Dry Dock Co.

Policy Re Motorships.

It has been confidently expected that some of the standard ships would be motorships. The Emergency Fleet Corporation, however, states definitely to this publication that for the present steam propulsion only is contemplated. Before endeavoring to lay any strictures upon the board for its decision in this matter it might be well to examine into the situation which doubtless resulted in this action.

Probably nothing made it more difficult for the Shipping Board to thresh out the oil engine situation than the absolute lack of standardization among the oil engine manufacturers of the United States. An effort was being made to evolve plans for a standard ship and in steam propulsion the board found standard equipment with which marine engine manufacturers in all sections of the United States were uniformly familiar. The claims of the oil engine were on the other hand being urged by a large number of exponents of almost as many different types. Manifestly to give a thorough test of each different type at this time was beyond question in view of the emergency existing.

This would seem to emphasize very strongly the need of some sort of a general organization among the manufacturers of marine oil engines in the United States with a view to advancing through uniform action whenever possible the interests of the marine oil engine as a prime mover. This publication makes bold to suggest that at an early date steps be taken towards a gathering of those engaged in the business with a view to forming such an organization.

The situation was further complicated by the fact that for over two years past usually heavy demands have been made upon American marine oil engine manufacturers by virtue of the construction of a large fleet of auxiliary power vessels and the unusual demand for engines for submarines. As a consequence the Shipping Board's call found practically every engine builder loaded to capacity with commercial work. It would have been possible unquestionably to have produced the required number of engines under pressure in time for the federal shipbuilding program. To have accomplished this would have required a co-ordination between government and engine manufacturers, which is perhaps unattainable under a republican form of government. The President declared the existence of a state of war upon April 6th, but two months elapsed before there was put

into effect by the Shipping Board a program which had been practically agreed upon before the actual declaration of war. This does not indicate an ability upon the part of the government to act with the swiftness of decision which would be necessary to the successful fruition of a plan to fit the emergency fleet with oil engines.

The construction of at least a few oil engined carriers from the standard plans would have furnished a great deal of valuable data and would have established standards of practice which would have aided merchant shipowners in forming the plans for the future. It is doubtful whether, taking all the circumstances into consideration, this would have been a fair test for the full-powered motorship. Notwithstanding the fact that any decision which the government arrived at with regard to oil-engined vessels might have been in the nature of a compromise in view of the variety of types offering the results would have been accepted by most shipowners as final, without careful consideration of all of the circumstances incident thereto.

We do not believe that at any time proper emphasis was given to the fact that the motorship is the ideal craft to elude submarines. Absence of smoke and funnels make the motorship invisible at sea at shorter ranges than any other type of carrier and this would alone have justified an unusual effort to provide the standard ships with suitable oil engines in order that they might with the greatest degree of efficiency fulfill their mission as blockade runners.

It is unfortunate that so much time has been consumed in arriving at a decision, the result of this having been to tie the hands of manufacturers as far as private business was concerned as long as deliberations were in progress at Washington. Commercial offerings are heavier than at any other time in the history of the business and the next few years promise to be unusually busy ones for the marine oil engine manufacturers of the United States.

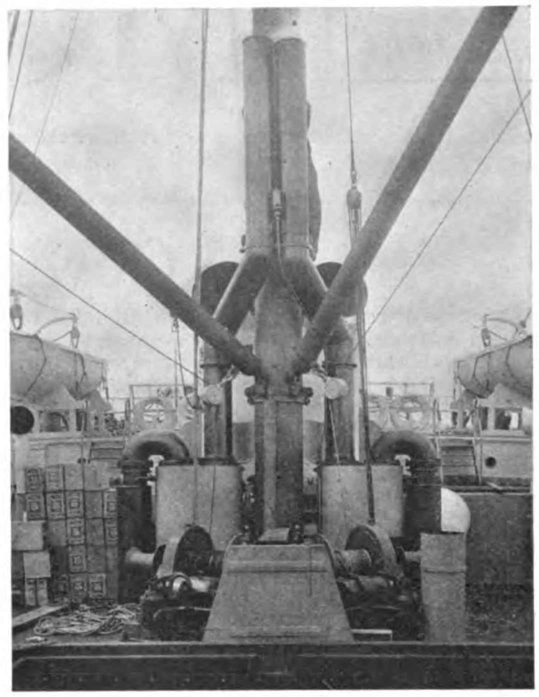
The decision of the government to make its steamships coal burners instead of oil burners is explained on the ground of alleged difficulties in fueling the latter type. It is claimed that with the use of coal-burning vessels fuel need only be carried for a one-way trip, as fuel can be secured at both termini. Frequent coalings are a dubious advantage in our opinion.

The Split in the Board.

The importance of the differences between Major General George W. Goethals and the United States Shipping Board have been greatly exaggerated. When several young American engineers advanced the plan of building 1,000 wooden ships in eighteen months in order to overcome the German submarine blockade, the scheme was seized upon with avidity at Washington, D. C. While the plan was under consideration by the Shipping Board the press of the country accepted it as an established fact and lent to the original plan an apparent endorsement, which was much stronger than any which it has ever received officially.

When General Goethals was called to his post as manager of the Emergency Fleet Corporation he found himself apparently committed through public sentiment to a plan to engage immediately in the construction of a wooden fleet of this magnitude. Now a recent optimistic survey of the wooden shipbuilding facilities of the Pacific Coast indicated the ability to turn out about 180 vessels a year of the standard type under highly favorable conditions. The Pacific Coast has today 70% of the facilities of this character in the United States. The total production capacity of the country on this basis would therefore not exceed 250 vessels a year, or 375 for the eighteen months period, and this is of course assuming uniformly favorable conditions.

With this condition confronting him the General went into conference with a committee of steel manufacturers and upon receiving their assurance that the steel would be forthcoming, proceeded, and it might be said, very wisely, with his steel shipbuilding program. Proposals were made by the United States Steel Corporation and the Lackawanna Steel and Iron Co. to turn out by fabrication processes 3,000,000 tons of steel



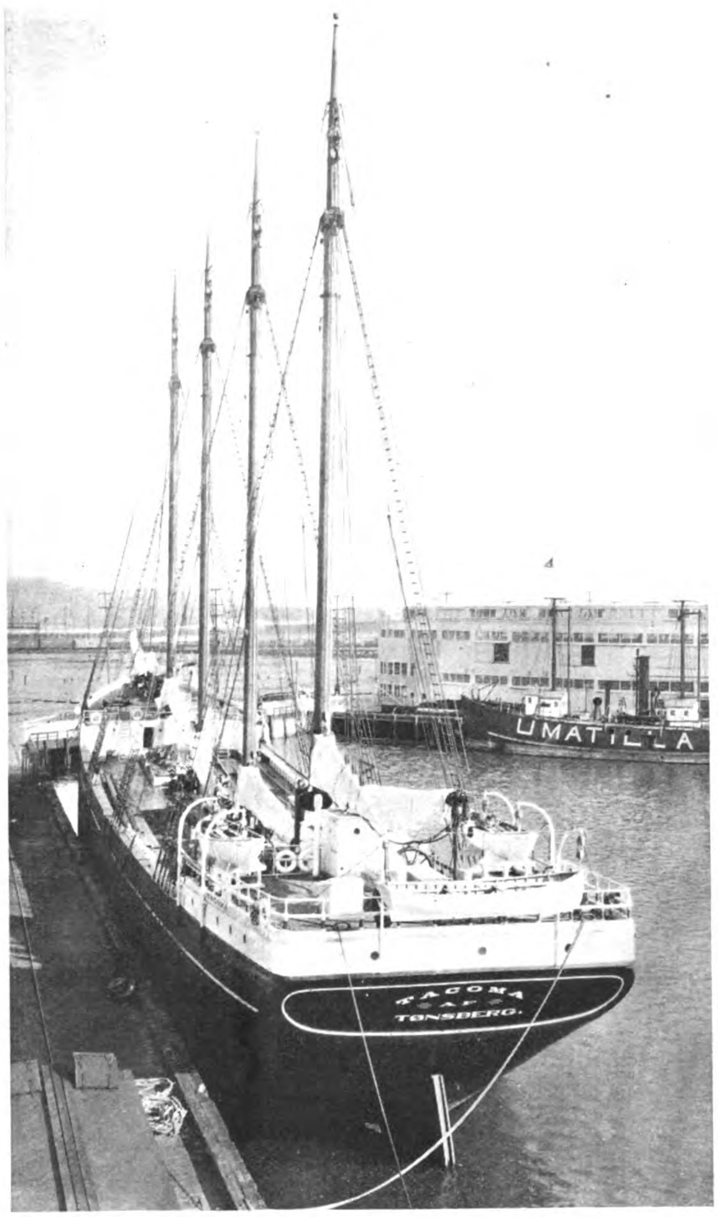
DECK OF "TACOMA" LOOKING AFT SHOWING EXHAUST BOXES AND VENTS, ALSO ELECTRIC CARGO WINCHES

shipping in eighteen months and these have been accepted.

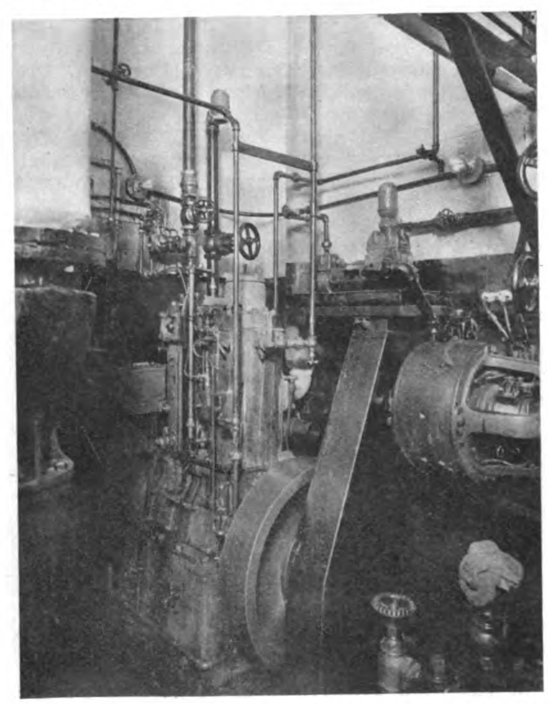
While the issues have perhaps been beclouded by over enthusiastic "boosters," locally upon the Pacific Coast no one in the shipping world has considered wooden vessels as more than a temporary expedient, but the present emergency justifies the construction of maximum tonnage, and therefore wooden vessels must be built in the largest possible number. This is very clearly indicated by the amount of wooden construction now on the stocks for private account.

The employment of large oil-engined merchantmen should in no wise be confused or inseparably attached to the wooden shipbuilding program. Motorship has striven to keep before the trade the example of European builders in illustrating from time to time the full-powered steel oil-engined vessels of the most modern type built abroad, and it is to be hoped that henceforth more progress along these lines will be made in the United States.

After two months of painful indecision the Shipping Board's program is now moving forward in a well-oiled way. The one blot upon the face of the matter which will linger for some time is the General's unsoldierly criticism of his superiors at a public banquet in New York.



AUXILIARY MOTOR SCHOONER "TACOMA"



10 B. H. P. MEITZ COMBINATION AUXILIARY COMPRESSOR DRIVING 6 K. W. WESTINGHOUSE GENERATOR

Design and Specifications of the Standard Wooden Ship.

The government's standard wooden ship is the work of Theodore E. Ferris, the well-known New York naval architect, and we append in condensed

Continued on Page 10)

Mietz Engined Auxiliary Goes Into Service

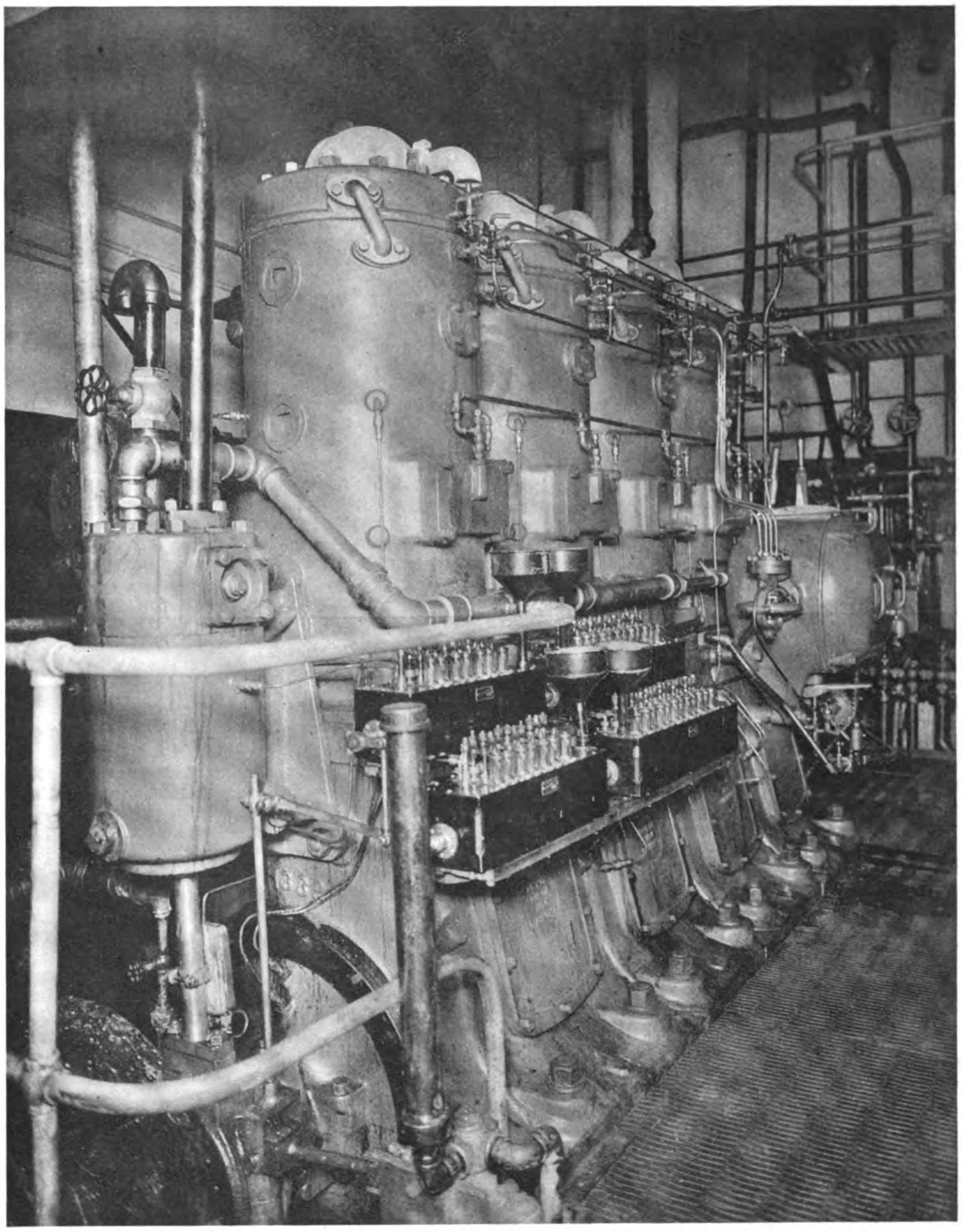
THE latest Pacific Coast installation of the Meitz surface ignition marine type oil engines has been undergoing minor tests in the auxiliary schooner "Tacoma", built by the Washington Shipping Corporation. These engines are 240 b. h. p. in four cylinders, 14x18½ turning at 240 r. p. m.

No lengthy trial runs will be attempted until the vessel now loading at Tacoma is in deep trim. It has, however, been found necessary to change the original propellers to a smaller set, one of which lost its blades at Tacoma and when the vessel is again docked we are informed that a third set is likely to be tried as the second wheels were unsatisfactory in being too small.

Following the vessels return to Seattle from Tacoma extensive official trials will be held, and the data obtained will be given in our July issue. From the accompanying illustrations a general idea of the engines and installation may be obtained also the system of exhaust boxes illustrated in the deck view.

The engine room is spacious and well ventilated and entered from the main deck at after end. At the forward end there is a gallery and at the after end there is a raised grating upon which is installed a 120 b. h. p. Meitz stationary direct-connected to a 75 K. W. Westinghouse generator, supplying current for electric deck auxilliaries. There is also a 6 K. W. generator of the same make chain-driven from a 10 h. p. Meitz auxiliary air compressor unit at the lower level. Considerable care and thoroughness has been exercised in the installation of both the main engines and auxiliaries and minor improvements made during the limbering-up stage.

The exhaust boxes shown in the deck illustration form very effective mufflers, the gases striking down upon the water, which is maintained at a low level in the tank, and then escape perfectly clean through the stacks port and starboard.



"TACOMA'S" PORT ENGINE, MEITZ, 240 B. H. P., FOUR CYLINDERS, 10x18½, 240 REVS.

OPERATIONS OF THE WASHINGTON SHIPPING CORPORATION.

The "Remittent," launched May 19th, is the third auxiliary motor schooner from the ways of the Washington Shipping Corporation, Seattle, during the past four months.

"Tacoma" (No. 1), "Portland" (No. 2) and "Remittent" (No. 3) are sister vessels of the four-masted auxiliary motor lumber schooner type, as standardized by this yard, and of which there are four more now under construction.

M. S. "Tacoma," equipped with a twin set of Mietz oil engines, is undergoing a change of propellers at the Seattle Construction & Dry Dock Co. prior to her official trials. "Portland" and "Remittent," equipped with similar installations, are rapidly being pushed through the finishing stage. "Portland" and "Tacoma" are reported to be sold to the Pacific Motorship Company of Christiania, Norway. "Remittent" and No. 4 are to the order of Alexander Prebsen of Risoer, Norway.

With additional ways this yard expects to launch a vessel every thirty days.

NEW FAIRBANKS-MORSE PLANT AT BALTIMORE, MD.

Fairbanks-Morse & Co. of Chicago has purchased outright the plant formerly occupied by the Charles White Gas Engine Co. at Charles and Winder Streets, Baltimore, Md.

The company has a sales branch in Baltimore but the newly acquired factory will be used for the construction of their heavy marine oil engine, which at present is being manufactured by a subsidiary plant, the Sheffield Car Company, at Three Rivers, Mich., the output of which is too limited to fill the increasing demand for the Fairbanks-Morse C. O. type marine oil engine.

YARD OF WASHINGTON SHIPPING CORPORATION, SEATTLE, WHERE THE "TACOMA" WAS BUILT
Left, "Remittant"; Right, "Portland." Three Sister Auxiliary Motor Schooners on Stocks

Activities of the National Shipbuilding Co.

NEW YARDS OF NATIONAL SHIPBUILDING CO.

THE National Shipbuilding Co., of Seattle, Wash., are rapidly transforming the old plant and additional ground acquired at Georgetown into a modern shipyard of considerable size and importance.

Several vessels are on order and of the following types and dimensions:

No. 4.—Motorship, 155 feet over all, 36 feet beam, 15 feet 5 inches moulded depth. To be equipped with a 300 b. h. p. Atlas Diesel, and 40 h. p. Atlas generating set for electric deck hoists and anchor windlass. This vessel to the order of the Apex Fish Co. of Seattle.

Nos. 5 and 6—Sister vessels of the auxiliary motor schooner type, five mast, bald head, fore and aft rig. Dimensions, 280 feet over all, 48 feet beam, 27 feet moulded depth. The power equipment of these vessels will be twin sets of 350 b. h. p. Skandia oil engines, supplied through the Skandia Engine Agency of Seattle.

The electric cargo hoists and anchor windlasses for all three ships will be supplied by the Pacific Machine Shop of Seattle.

The Loss of the "Sebastian"

AFTER a most successful career since her conversion to four-cycle Diesel power, the British oil-carrying tank motorship "Sebastian" was destroyed by fire and sunk in 200 feet of water off Nantucket Shoals while en route for Europe with a load of fuel-oil for the Allies. Under no circumstances should this accident be used for the purpose of derogatory argument against the construction and use of Diesel motorships, for manifestly a motorship using crude-oil fuel without the use of exposed flame is far more safe and free of fire danger than oil-fired steam engines and boilers.

Since the war many allied steamships have had mysterious fires while lying in American harbors, or shortly after leaving port, and likewise the recent burning of the tanker "Sebastian" is surrounded in mystery; but certainly the fire cannot have been due to the Diesel principle. The matter, however, is most regrettable, particularly as she has been a most successful vessel since her conversion, she having had no engine repair-bill.

Motorship has made every effort to secure an absolute impartial report and has had interviews with both the Chief-Engineer and the Captain. It appears that the Chief-Engineer, when in his cabin, noticed by the sound that one of the engines had stopped and that the other was slowing down. So he quickly went down below, and noticed that the fuel-oil had started to overflow from the filter, which is mounted on a grating over the engines, the fuel-supply-bottles that are suspended on a balance, having run dry (probably due to a chokage between the filter and the reservoir supply-bottles). The fuel-supply bottles running dry, of course, stopped and slowed down the engines respectively. Suddenly there was a tremendous flash of flame and the entire engine-room was on fire, the fire instantly spreading right across in a big blaze.

Now, the engine exhaust-pipes and the short extensions to each cylinder-head were lagged with asbestos, with the exception of three expansion-joints on the exhaust-pipes and the flanges connecting the extensions to the cylinders.

This fully indicates that the fire had absolutely nothing to do with the Diesel engines, because the exhaust-temperature could not possibly have been sufficiently hot to ignite fuel-oil, and nowhere could there have been an exposed flame from the engines. To us it seems that there must have been some enemy plot that was arranged either before the ship left port or while the ship was at sea. Probably some highly inflammable chemical or gasoline was mixed with the fuel-oil before or after it was put in the bunkers. That the fire should have extended all over the engine-room adds to the mystery.

"The remarkable thing," said the Chief-Engineer, "was the entire suddenness and extent of the blaze."

The mean temperature of the exhaust-gases of the "Sebastian's" engines under normal full-load conditions is about 700 degs. Fahr., whereas, when the accident occurred, one engine had stopped owing to a stoppage of the fuel supply, and the other had slowed down, so that the exhaust-gas temperature must have been very low when the fire started. There was no electrical sparking device on the engines to start a fire.

Mr. Arthur West, of the Bethlehem Steel Co., since has made some tests with a high-powered gas engine at their works. While the engine was running at a big overload and with high exhaust-temperature, fuel-oil of 33 degs. Baume at 75 deg. Fahr. (solar-oil was the residual fuel used by the "Sebastian") was poured over the naked uncooled exhaust-pipe; close to the cylinders; but under no circumstances could they produce a flame,—just a smoke, that's all! Kerosene then was tried with exactly the same results.

Now, this test was very severe as it was made with an engine running at an overload and without an asbestos-covered or water-cooled exhaust pipe, so it is obvious that the residual-oil fuel known as "solar-oil" running on to the exhaust pipe, or any other part, of the "Sebastian's" engines could not have caused a fire, and so supports our theory of a plot. No engineer of common sense would consequently blame the Diesel principle as the cause of the fire.

However, the position of the fuel-filter on a grating over the engines was not a good one, and here it may be mentioned that the builders of the engines did not carry out the installation. The ship was not a new one, and the Diesel engines were fitted in rather a small space at the stern, which probably accounts for the position of the fuel filters, and they should have been arranged elsewhere. Most of the old steam auxiliaries were retained, and at one end of the engine-room was an oil-fired donkey-boiler, but whether this boiler had anything to do with the fire we do not know.

On her last voyage to the U. S. A. the "Sebastian's" engines both made a 16-day run without stopping, even for a few minutes, the ship averaging 8.8 knots in heavy weather, although three of the assistants in the engine-room had never before been to sea in a motorship, which fact speaks for itself.

THE SHIPYARD OF HENRY PIAGGIO AT ORANGE, TEXAS. SEE OPPOSITE PAGE FOR DESCRIPTION

An Ideal Submarine Chaser

A 135-Footer That Will Be Ten Times as Effective as the 110-Footers Now Building

FOR some time past we have been giving our most careful attention to the question of submarine chasers, and while we consider the 110-footers now being built for the U. S. Navy Department as being better than those built for England, they are by no means ideal. As a matter of fact they almost represent the minimum of size and speed—more particularly size—that sea-going chasers should have.

The submarine-problem is far more serious and vital than the man-in-the-street imagines, and it is our earnest recommendation to the Navy Department that it at once has built at least fifty craft to the following dimensions and equipment. Building such craft is far more important than any other type of naval craft with the exception of torpedo-boat-destroyers, and, if ordinary naval constructional work were stopped for six months at one big shipyard, a large number of such craft could be turned out, and then ordinary naval work could be resumed.

The following are the approximate dimensions and details; but it may be advisable to slightly vary the dimensions to suit given conditions or design; but this will rest with the naval architect:

Length	135′ 0″
Breadth	20′ 0″
Depth	10′ 0″
Draught	7′ 0″
Power (normal) sustained	1,000 b.h.p.
Power (emergency) sustained	1,100 b.h.p.
Speed (full)	17-18 knots
Speed (cruising)	14 knots
Fuel	Crude or residual oil
Type engines	Submarine Diesel (four-cycle)
Screws	Twin
Guns	Two 15-pounders and two anti-aircraft
Construction	Steel

We further maintain that such vessels and their machinery can be built in this country without interfering with existing naval constructions—not in a month; but in six to twelve months, according to the number ordered, and if the Navy Department does not know where, we shall be pleased to advise them, or even see that they are built to Government supervision provided we are given a free hand.

At the end of this article we have dealt with the enormous demand on the gasoline supply that the 110-footers now building will mean, and we also show how, if these had been fitted with Diesel engines, the saving in fuel alone would have meant about twenty-one million dollars per annum.

Craft conforming to these, or similar, requirements, would be capable of keeping the seas in the heaviest of weathers, and would have an armament that could effectively be used against the German submarines, whose decks are fairly heavily armored, and who in a surface fight would quickly make mince-meat of some of the 80 ft. and 90 ft. wooden yachts with one and three-pound guns that some persons fondly imagined could be used against the submarines. In addition to having armored decks the latest U-boats carry two 4.5 guns, which they have been using to sink large steel merchantmen, in order to save their torpedos for more formidable foes.

These 135-footers when used for convoy purposes in the danger zone could render submarines almost totally ineffective, and this would largely be due to the use of Diesel-type crude-oil engines for propelling purposes. Boats fitted with these engines and carrying as much fuel as ordinary gasoline-engined patrol boats, will have in comparison about 50 per cent of the fuel to spare without reducing their cruising radius. Round the side of their hulls should be fitted copper pipes with holes in them, this copper-pipe being connected with a pump attached to the fuel-tank. Thus, in case a submarine is about, these chasers can cruise around at high speed, spraying crude-oil fuel on to the water. A dozen boats could cover a tremendous area in less than a half-hour, so if the submarine came up within any point in that area, she would be temporarily blinded by the crude oil adhering to the lens of their periscopes.

For instance, a transport, liner, or freighter, convoyed by about four of such boats would almost be immune from attack, because the oil sprayed by the convoys as they dashed around the ship at twice the speed, would temporarily put the periscope of the submarine out of action, and she could not see from her periscope to fire a torpedo. No other craft could distribute the oil effectively enough in such a short space of time. Hence, while these chasers were in attendance these convoyed vessels would almost be immune from attack.

Let us now get down to more technical details. At full speed each boat would use a little over 500 lbs. of fuel per hour, or 5⅓ tons maximum per 24-hour day; but, as this speed would not be maintained the average fuel-consumption would hardly be likely to exceed 3½ tons per day, including auxiliaries. She probably would be re-fueled by the supply tank-ships every four or five days, so that for fueling purposes would carry about 18-20 tons which would be sufficient for 1,650 to 1,750 nautical miles cruising at about 14 knots.

Now, a boat of this size should be able to carry 30 to 40 tons of crude-oil fuel, so that she would have 10 to 20 tons of reserve fuel-oil, which she could use for spraying on to the water without interfering with her cruising radius of about 1,700 miles.

Furthermore, this oil could be used for calming the seas in rough weather when it is desired to launch boats for rescuing sailors from a torpedoed or mined ship. Again, should they run short of fuel it would be a fairly simple matter to run alongside of some passing merchant steamer, or motorship, and obtain some fuel-oil, because most trans-Atlantic steamers are oil-fired. None of these things could be done if gasoline engines were used for propulsion purposes, as is the case with the chasers now building, and with those in service.

Regarding Diesel engines, reference to the submarine-Diesel engine article in our April issue will reveal that there are several suitable motors. We will take one that particularly lends itself to these patrol boats.

It is of the four-cycle type, and with six-cylinders 380 mm. bore by 380 mm. stroke develops 500 b. h. p. at 400 r. p. m., or 550 b. h. p. at 450 r. p. m. With reversing mechanism the weight is 13 tons. This engine is about 16 ft. long, so will not take up much room.

An auxiliary motor of about 50 h. p. will be required, also one of about 4 h. p., and for these gasoline motors could be used in order to save weight. Hence, the two main engines, air-bottles, engine-room auxiliaries, etc., should not exceed 32 tons, so that together with fuel, reserve-fuel, and fuel-tanks the total machinery weight should not exceed 65 to 75 tons, which a 135-footer should be able to accommodate. But, if necessary the whole could be reduced considerably, by reducing the power and the amount of fuel-oil carried. Because of the small amount of space required by the engine-room (30 ft. would be more than ample) there would be left 105 ft. for accommodation for the crew, water, stores and fuel; although much of the fuel could be carried in the double-bottom of the hull.

Undoubtedly one boat built along the above lines will be ten times as effective as a gasoline-engined 110-footer, and certainly the Navy Department should at once build a dozen trial craft, if not fifty.

Furthermore, Diesel-type engines should be installed in many of the 110-footers now building, and such a change would greatly increase their effectiveness, many of the above reasons also applying. Three submarine Diesel type oil engines of 240 b. h. p. per boat could be fitted, for such engines can be obtained on a weight of about 5 tons per engine. Not only would the crude-oil be valuable and safer, but their present cruising radius would be doubled on the same bunker capacity.

It is the opinion of Mr. Arthur West, of the Bethlehem Steel company, that the general scheme of using submarine-type Diesel engines for these chasers looks decidedly good. The principal question in his mind is the method of obtaining plenty of compressed-air for starting the main Diesel engines without using undue space and weight for independent compressor and air tanks on these small boats.

He thinks it is possible that a small four-cycle automobile type gasoline engine with a standard automobile friction clutch might be coupled to a standard small high-speed compressor, such as is used on street cars. The main Diesel engine itself should, as in a submarine, be non-reversible, going astern with some approved form of standard reversing gear. The auxiliary compressor would then only be rarely required, and only a small amount of gasoline need be stored.

It also seems to Mr. West that such boats using heavy oil as fuel would be very much safer against fire than gasoline boats, particularly when of a large size.

Furthermore, the supply of heavy-oil would be very much greater than gasoline, and would tend to relieve the tremendous demand for gasoline for other purposes, such as aeroplanes, automobiles, tractors, etc., where nothing but gasoline is at all possible.

Mr. West further says that in view of the tremendous number of these chasers now built and building, the difficulty of an adequate supply of gasoline seems a very strong argument for the building of future boats of this type with heavy-oil engines, and that if fuel is not used for spraying on the water, such boats would have twice the cruising radius of the gasoline-driven boats of the same horsepower, and the same amount of fuel, which, in itself, seems almost enough to justify the change, because the boats could then stay away from their bases twice as long.

Regarding the amount of fuel used, we ourselves would like to add a few words, namely, the 110 ft. gasoline boats now building will be fitted with three gasoline engines, each of 220 b. h. p. that is to say, at full speed they will have a fuel consumption of about 7 tons per 24-hour day, which compares with 3½ tons for a Diesel-engined boat of similar power and speed, or compared with 5⅓ tons for Diesel engines of a 135 ft. boat of the same speed, and nearly double the power.

In view of these remarks, which are backed by such an authority as Mr. Arthur West, it is obvious that they warrant very careful attention by the Navy Department.

Altogether contracts have been placed for 340 110-footers, so that these boats, when completed, will use, if they average a cruising speed, about 5 tons per day each, or a total of 1,700 tons of gasoline every 24 hours. This, for one month of steady operation, will mean 51,000 tons of gasoline, without counting full-power running. This in practical figures means one and one-quarter million gallons of gasoline a month, which will be required to drive the patrol boats, and naturally it would be a considerable drain upon the supply of gasoline. Hence, you will realize why it is important that the Navy Department equips a large number of these chasers with Diesel type oil engines, using crude-oil fuel, of which there is a much bigger supply, and the saving on the fuel bill alone would be enormous. The fuel bill of these boats with gasoline at 20c a gallon will be in excess of about $24,000,000 a year which compared with about $3,000,000 per year if all the 110-footers were Diesel-driven, and with the fuel-oil at 5c per gallon.

WOODEN MOTORSHIP CONSTRUCTION IN THE SOUTH.

The Shipyard of Henry Piaggio.

IN a recent issue we published illustrations and details of a new shipyard at Brunswick, Ga., where a number of motor auxiliary sailing vessels are under construction. We now give an interesting illustration of the new wooden shipyard at Orange, Texas, of Mr. Henry Piaggio, of Gulfport, Mississippi, who is well-known in the lumber industry. This picture shows five auxiliaries—four under construction and one completed.

The latter is the "City of Orange," a five-masted schooner, 234 ft. long b. p., with 43 ft. breadth, and 21 ft. 8 in. depth of hold. This vessel is fitted with two surface-ignition type of oil engines, each of 150 b. h. p.

Reading from left to right on the illustration are the following, "City of Houston," "City of Pensacola," and two vessels as yet unnamed. The "City of Houston" is a sister to the "City of Orange," except that her power is greater, being two 200 h. p. crude oil engines.

The "City of Pensacola" is expected to be launched before these words appear in print. She is 172 ft. long by 36 ft. beam and 15 ft. depth of hold. Her propelling power will consist of twin 100 h. p. surface-ignition oil-engines. The two unnamed craft both are 246 ft. long b. p., 45 ft. beam, and 21 ft. 8 ins. depth of hold, and will be equipped with twin 200 b. h. p. surface-ignition oil-engines.

At Beaumont, Texas, Mr. Piaggio has building two schooners similar in size to the "City of Pensacola." At a later date we hope to have more to say about these various vessels.

WAR ACTIVITIES OF INTERNATIONAL MERCANTILE MARINE COMPANY.

IN connection with the quiet campaign of preparedness which is being carried on under the orders of Franklin D. Roosevelt, Assistant Secretary of the Navy, and about which there has been no previous public announcement, an active effort has been under way during the last month to procure sea-going yachts for immediate war duty. Vessels of this kind must be not under 110 feet in length, with sea-going ability and of large cruising radius. The Government will employ a large number of such vessels as auxiliaries to the other fighting units of the Navy, and the patriotic spirit of many owners who have already come forward to turn over their vessels for this valuable service is worthy of commendation. Not only from ports on the Atlantic Coast, but from various points on the Great Lakes a fleet is being rapidly mobilized, and a number of fine yachts, now in process of alteration, will very shortly be added to the fleet of the Navy.

About a month ago the Assistant Secretary of the Navy organized a Special Board for Patrol Vessels, whose duty is to secure suitable boats with all possible dispatch. One of the first moves of this board was to have the International Mercantile Marine Company, 9 Broadway, New York City, designated as the official agents of the Special Board. This brings to the assistance of the Navy in these times of stress the services of the International Mercantile Marine Company's large staff of shipping experts, all of whom are giving their services without remuneration. The Navy yards in their present crowded condition, are thus relieved of a great deal of work, and under this new arrangement owners also are assured of immediate payment for their boats, dispensing with the time-consuming formalities which ordinarily are followed in dealing with the Government departments. The International Mercantile Marine Company is also supervising all alterations above and below decks, arming, outfitting, coaling and provisioning the ships and delivering them, painted in war colors, to the Navy Department for seaduty. The Special Board for Patrol Vessels is acting in an advisory capacity and is preparing to man all these ships promptly. Such well-known yachts as "Carola IV", "Nokomis I", "Emeline", "Wanderer", "Corona", "Zara", "Remlik", "Sialia", "Alcedo", have already been taken over by the Government and are in process of alteration.

There is at present before Congress a bill authorizing the requisitioning for this special sea service all available boats of suitable size and other qualifications, but before this law becomes effective the Special Board for Patrol Vessels and the International Mercantile Marine Company would be very glad to hear from any yacht owner who cares voluntarily to offer his craft for service against the enemy. The work to be accomplished is of an extremely important military nature, so that any owner placing his boat at the disposal of the Government will render the greatest possible service, and, owing to the arrangement with the International Mercantile Marine Company, will receive payment without delay or formality.

WILL PRESENT CRUISER TO U. S.

Commodore Carleton Earl Miller of the San Francisco Yacht Club has rechristened his express motorboat cruiser the "Del" and after having her lengthened twenty feet proposes to present her to the government as a submarine chaser. The boat is equipped with a six-cylinder 100 h. p. Van Blerck gas engine and has at present a speed of 22 miles an hour. The reconstructed boat, however, will have another engine of equal power, thus giving her far greater speed possibilities. But few of the San Francisco motor boats offered to the U. S. Navy for war uses have been thus far found acceptable.

GOVERNMENT COMMANDEERS THE "ANGEL."

The motorship "Angel" recently equipped with a 225 h. p. four-cylinder Union gas engine in Oakland, has had a satisfactory trial trip and has now been commandeered by the United States Government for use as a general supply boat in connection with war preparations on the Pacific Coast. The vessel is owned by the Merchants Navigation Co., of Los Angeles who recently purchased her in Portland, had power installed and other improvements made with the view of engaging her in the Southern California and Mexican coast trade.

PATRIOTIC ACT OF WILCOX, CRITTENDEN & COMPANY.

In response to the national appeal, Messrs. Wilcox, Crittenden & Co. of Middletown, Connecticut, have taken a block of Liberty Loan Bonds to the amount of $50,000.

UNIQUE CEREMONY AT PUGET SOUND NAVY YARD.

During the Bremerton Navy Yard noon hour recess of Tuesday, May 15th, in the presence of a large gathering of naval officers and their wives, Ruth, the four-year-old daughter of Lieutenant and Mrs. Hiram L. Irwin, drove two tiny gold spikes with a gold hammer of equally puny pro-

RUTH IRWIN, FOUR-YEAR-OLD SPONSOR

portions into the keel scarf of the first submarine chaser, No. 288. After the scarf had been officially fastened the gold spikes were withdrawn and presented to the dainty little lady who had so charmingly acted as sponsor.

Present indications are that No. 288 will be ready for service about July 15th, after which it is expected that one chaser every five days will be turned out.

MEXICAN-BUILT MOTORSHIP.

A passenger and freight motorship is being laid down by Mr. Manuel Angel Fernandez of Vera Cruz, which is said to be the largest undertaken in Mexico. It is to have a single deck and is to be 130 ft. long, 25 ft. wide, and of 10 ft. draught. The tonnage is to be 200 net and 250 gross. The propelling machinery is to be an engine of the Diesel-type of 200 h. p. and electrically-driven auxiliary engines made in the United States. The boat will ply along the gulf coast of Mexico.

AUXILIARY SCHOONER "ASTRI."

The auxiliary schooner "Astri" built by the McEachern Ship Yards of Astoria and owned by the A. O. Andersen Co., Ltd., is about ready for commission which will follow the trials of her twin 320 b. h. p. Bolinder oil engines.

SUBMARINE CHASERS.

THE most practical discussion on submarine-chasers we have yet read in any of the motorboating magazines appears in the April issue of our contemporary Yachting. Hitherto, the various domestic pleasure-boating journals do not appear to have been able to distinguish between the requirements of coastal or harbor patrol-craft and sea-going submarine chasers. Their tendency (and the daily-press unfortunately has followed their lead) has been to make motorboat and motoryacht owners believe that their craft, which mostly vary from 40 ft. to 90 ft. length, will be used by the Navy for submarine chasing at sea, whereas they actually are being, and will be, used for general police-work in harbors, sounds, bays, rivers, estuaries, and a few miles off shore, for which purpose they are most valuable, as they relieve larger vesels of the Navy of certain important duties that must regularly be carried out.

Fortunately the editor of Yachting is a seagoing man with common sense-views, and evidently prefers to publish sound advice, rather than "play to the gods." Fewer daily-paper journalists, and more technical men on the staffs of motoryachting magazines would avoid the publication of much misleading rubbish at a time when the honor of the nation is at stake. Yachting says:

> "After authorizing two high-speed power patrol boats last year the Government has decided that they are too small (one was 66 feet in length, the other 45 feet) and that boats of at least 100 feet in length are necessary to do effective work on patrol or for the detection of submarines. In this the Department is right, for most of the power boats built so far that have sufficient speed to be of use would be absolutely worthless from fifty to one hundred and fifty miles off shore, if they had to stay on station. And, if a submarine attack should be made on this coast, it would probably be made against shipping in the steamer lanes and off the mouths of the large ports, with very little chance of the enemy risking these craft in harbors and close to the shore.
>
> "In England, the 80-footers which they bought in such large quantity have proved in some measure unsuited for the work which was desired of them, as they did not have the size, or the qualities to permit them to keep to sea in the English Channel and the North Sea at all times, winter or summer, and were not large enough to give a stable gun-platform when the weather was at all rough—faults which were due to the government ordering the boats not knowing itself what was wanted. This is an error that we ought to be able to avoid in the light of the last three years abroad, if we will but profit by the example before us. The boats that have borne the burden of this service on the other side, if we can believe what the Admiralty has permitted to get out, are the steam trawlers and the big auxiliary fishing boats with which England was so plentifully supplied before the war. These boats are large enough and able enough to go out and stay out, and to do hard, rough work, but are deficient in speed. They have been used for mine-laying and tending of submarine-nets, and also for the actual capture of many submarines.
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> "What is wanted, therefore, is a boat big enough to go offshore and stay offshore, with sufficient beam and stability to mount guns of sufficient calibre to be of some use and on a platform stable enough to make the firing reasonably effective. We believe in most of the boats designed, the consideration of speed has been paramount to that of sea-going ability and, when need was seen of the latter quality, the boats were merely made larger, maintaining the same characteristics of the out-and-out speed boats.
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> "Most of them have been all on top of the water with very little underbody and practically a flat bottom from amidships aft, with straight sheer and sharp, deep forefoot that would make them hard to steer in a heavy sea. What such a boat would do in a hard sea, whether it was ahead, quartering, or dead aft, can be imagined, and they would have to run for shelter if caught in a moderate gale fifty miles from land."

CRANES FOR SHIPYARDS.

AMONG the new advertisers in Motorship are Messrs. Wellman, Seaver & Morgan of Cleveland, Ohio, a firm with an enviable international reputation for shipyard and floating cranes of large proportions.

In the "1917 Merchant Marine" Shipyard Crane, built by this concern is embodied the prime characteristics essential to the speedy and economical handling of material for the building of modern ships.

This crane does a crane's work with certainty, dispatch and safety at 100 per cent efficiency. Its simple purpose is to lift material and swing it into the required position, and its operation realizes the maxima of speed, economy and safety. It is not a combined transporter and crane, nor a general utility machine for an entire shipyard.

Its function is specialized, as just stated, and it gives all the benefits attendant upon true and proper specialization. For this reason it does not suit the conditions of every shipyard. They build other cranes to suit other conditions, but the "1917 Merchant Marine" Shipyard Crane is the type evolved from previous experience for adaptation to modern high-speed shipbuilding methods.

In the evolution of this type one witnesses a reversion to a practice that is very old in shipbuilding and which has persisted to a certain extent on a small scale through the changing methods of the past and present centuries. This reversion, however, is accompanied by such a speeding-up and such an increased intensity of service that the relation between the modern type and the prototype is one of principle only and not of construction.

In many of the old-established, but still successful, steel shipbuilding yards of England and Scotland the old wooden shipyard practice has survived of flanking the slips with a number of derricks which permit the handling of material simultaneously at different points without mutual interference. This is crude, but effective withal.

Modern shipyard practice now has intensified the system. A building slip flanked by a series of the Wellman-Seaver-Morgan hammerhead cranes of the "1917 Merchant Marine" type provides an intensity of service that permits construction to be speeded up to a rate which not so very long ago would have been considered unattainable.

A great saving of time is accomplished by handling the material with these cranes. On the one hand a travelling crane necessarily loses time in its movements, and if it be not on elevated tracks it is subject also to delays by obstructions on the ground, while on the other hand the hammerhead crane with its firm base is a stable structure, free from any such causes of lost time and able also to operate at higher speeds because of its greater stability.

By the fact that it is always in a known position, and not traveling from one place to another, it does not divert the attention of workmen and thereby it eliminates the loss of unproductive workers' time. It is recognized by workers as a safe machine that does not need to be watched by them.

Its large range of operation, the swing having a radius of 95 feet, enables it to be kept actively occupied, so that it earns money continuously by direct result, as well as by the greater productiveness of labor which it encourages.

Not the least of its advantages, and one that gains additional importance during the present period when greatly increased production of tonnage is being urged and demanded by the necessities of the world, is the facility of its installation. The foundation is easily prepared, and the erection of the crane can be carried out very quickly.

In the past the Wellman-Seaver-Morgan Company made a feature of designing cranes to meet unusual special requirements or to conform to local distinctive conditions, and in order to secure compromises between efficiency, convenience and economy of mechanical transport.

A great deal of special work has been, and is, superfluous. It is costly both to buyer and seller. A greater benefit is to be derived by both parties from the use of standardized cranes.

Thus today the types of Wellman-Seaver-Morgan shipyard cranes are three in number only. In addition to the "1917 Merchant Marine" type there is a double-cantilever type and a gantry type.

Both the double-cantilever and gantry types have still a wide application. They are not capable of giving the intense service of the "1917 Merchant Marine" Shipyard Crane, but each in its own way can give a wider variety of service. They are more suitable for shipyards where the production is not so big nor so frantic, and where the lay-out of the yard is more compact and handy than is possible in a big yard.

In pontoon cranes the Wellman-Seaver-Morgan Co. claims to have beaten the world. A 250-ton floating crane for the Navy and a 150-ton pontoon crane are just completing, and similar pontoon cranes have been supplied to the Navy Department for service at Boston, Bremerton and Honolulu.

Among the customers of this company, besides shipyards, have been the Panama Canal, the largest steel plants in the U. S. A. and abroad, the railroad corporations, electric corporations, smelting corporations, great machine shops and, in fact, the leading representatives of all the great industries. They also have exported cranes to Spain, France, United Kingdom, Austria, Italy, Russia and Japan. Of these special cranes, those at the Fore River Shipyard and at the Navy Yard, Boston, are herein illustrated to show the character and robustness of the construction emphasized in these large machines.

THE AMERICAN AUXILIARY MOTORSHIP "JUNE."

Since she was placed in service last October the American-built and engined auxiliary motorship "June" has made a large number of coastwise voyages, of which the last (up to the time of writing—May 4th) was the most successful, on one day of which she logged 168 miles, there being no sea or wind. This gives an average speed under power of 7 knots but usually the speed is 6½ knots under average weather conditions. The fuel consumption is 320 gallons (8 barrels) per day.

She is equipped with two Fairbanks-Morse surface-ignition C. O. type oil engines, which were fitted with an electrical ignition starting device, but recently the engines of the "June" were changed to torch-heating for starting purposes, as starting with the latter only takes about 15 minutes, and, while electrical heating for starting only requires a few moments, it was found desirable to frequently renew the copper coil, as it got burned away by the constant combustion heat.

Her voyages are as follows: San Francisco to Balboa; Balboa to New Orleans; New Orleans to Gibara and to Gulfport, thence to Barbados and back; finally from Gulfport to San Juan and New York City. Her owner is Mr. M. T. Snyder, of New Orleans, La., and she was built by the St. Helens Shipbuilding Co. at St. Helens, Oregon.

Government Shipbuilding Program

(Continued from Page 4.)

form the specifications governing construction. The vessel has a length o. a. of 281 ft. 6 in. and b. p. 268 ft. Her beam over planking is 46 ft.; depth, moulded, at side of upper deck, 26 ft. Total estimated dead weight 3,500 long tons. Sea speed loaded 10 knots.

The vessel will be of the single-deck type with hold beams and shifting 'tween-deck beams; to have wood deck houses on bridge deck and on poop deck. Single or twin screw. To have elliptical stern and straight stem. To be schooner rigged with two wood pole masts, fitted with cargo booms and one smokestack.

To have four hatches at upper deck and small hatch at poop deck.

There will be four transverse caulked water-tight wood bulkheads extending to upper deck forming two cargo holds and machinery space

There will be a deep tank for water ballast and water tanks for boiler feed. Culinary water will be carried in separate steel tanks located in engine room. The afterpeak will be piped for fresh water for boiler feed and for salt water for trimming tank. The forepeak will be piped for fresh water only. Steam winches will be fitted at hatches for working cargo booms.

The amidship deck house on bridge deck will contain officers' quarters, wheelhouse, chartroom, wireless, gunners, quarters for petty officers, engineers, cooks, oilers, messmen, mess boys, etc. In the forecastlehead will be quarters for firemen and sailors, in the poop quarters for gun crew. The bridge space will be used for coal or cargo.

Propelling machinery will consist of one or two triple-expansion engines of 700 i. h. p. in twin sets and 1,400 i. h. p. in single sets, which is estimated to give the vessel a speed of 10 knots loaded; two single-ended Scotch boilers or water tube boilers fitted with heated forced draught for coal burning with one fireroom, together with all necessary auxiliaries, electric light plant, steam winches, warping capstan, steam windlass, steam and auxiliary hand steering gear, ice machine, steam-heating system, complete drainage system, all as described in specifications. (Twin-screw and geared turbine steam propelling machinery may be substituted, subject to approval of owners).

Supervision.

The work in all departments shall be done under the supervision and subject to the approval of owners' representative. He shall have authority to reject anything that is not suitable and in such cases it is to be made good at builders' expense.

Classification.

The vessel will be built to the requirements and under special survey to the American Bureau of Shipping to class A-1 for 15 years. This applies to the machinery outfit, electric equipment, together with all parts of the vessel. The vessel to be equipped and fitted in all requirements to meet and pass the United States Steamboat-Inspection rules in force for ocean service.

Insurance.

Builders to keep the vessel, including all outfit, fully and specifically insured both ashore and afloat until delivery (according to contract).

Drawings.

The drawings supplied by the United States Shipping Board Emergency Fleet Corporation, as prepared by Theodore E. Ferris, who shall be known as the owner's marine architect and engineer, also owner's representative.

Timber and Lumber.

The timber and lumber used in the hull except as otherwise specified, will be Douglas fir, grade select common. The stern post and rudder post will be gum or Japanese oak. The rudder stock will be gum or iron bark. The keel shoe will be of oak, treenails will be of locust or Japanese oak. Knees supporting hold and deck beams have been substituted by fore and aft clamps, shelf timbers and lock streaks.

Main Frames.

Double sawn of fir, sided 12 in., moulded on keel 26 in., at turn of bilge 18 in., top of bilge 15 in., at upper deck 10 in., at bridge, forecastle and poop continued up double, frames spaced 36 in. center to center.

Keelsons.

Main keelsons, eight in number as shown in midship section, of fir 20x20 inches in lengths 56 to 80 feet with 7-foot scarph girder keelsons, one each side of fir as shown in midship section. The first streak 12x16 inches locked over frames 2 inches. Second and third streaks 8x16 inches connected with 6-foot flat scarphs.

Bottom and side ceiling of fir 8x12 inches in lengths 40 to 60 feet, average 50-foot square butted. Side ceiling 10x12 inches in lengths 40 to 60 feet, average 50 feet, connected with 6-foot scarphs, one streak of side ceiling each side 12x12 inches, locked over frames. Bilge ceiling, three streaks each side, 14x14 inches, with five streaks between 12x14 inches, all in lengths 40 to 60 feet, average 50 feet, connected with 7-foot scarphs.

Garboard streaks of fir, first streak 10x18 inches in lengths 60 feet; second streak 8x18 inches in lengths 60 feet; third streak 6x18 inches in same lengths, square butted.

Iron Strapping.

As shown on fastening plan, top belt ¾ by 8-inch to extend from about 12 feet forward of No. 1 hatch to about 12 feet aft of No. 4 hatch, connected by triple riveted butt laps fastened to each frame.

Diagonal strapping ½ in. x 4 in. let into outside of frame and inclined at 45° each way will be fitted so as to meet at top belt in every frame space, connected to top belt by two ⅞ in. rivets and at each crossing by one 1 in. rivet, also fastened to each frame timber by 1 in. x 10 in. countersunk head blunt bolt.

Diagonal straps to be carried well down and wrapped around bilge far enough to overlap ends of floor timbers.

Outside Planking.

All of fir in lengths 30 to 60 feet, average 45 feet.

Bottom of planking 5x8 inches, bilge planking 6x10 inches, side planking 5x10 inches, 5x9 inches, and 5x8 inches, top side planking 6x9 inches.

The circle of stern between knuckle line and poop deck to be planked vertical.

Main clamp timbers of fir, two streaks each side 14x14 inches, one lock streak each side 14x16 inches locked over frames 2 inches;, clamp timbers in lengths of 40 to 60 feet, at ends of hull where shape requires these clamp timbers may be worked in two thicknesses.

Hold Beam Shelf Timbers.

Of fir, each side over hold beams, on streak 12x14 and one lock streak 14x14 locked in hold beam 2 inches.

Upper Deck Beams.

Of fir sided 12 inches, moulded 14 inches, worked within 9-in. crown shape 5 inches and spring 4 inches, beams spaced about 4 feet center to center.

Hold Beams.

Of fir sided 14 inches and moulded 16 inches spaced 4 feet centers as per framing plan.

Continuous Deck Girder and Hatch Coamings.

Of fir, one girder each side in way of hatch coamings, continuous from forecastle—head bulkhead to poop bulkhead, girders made up by two 14x14 inch hatch header and filling timber between through beams.

Transverse water-tight bulkheads, planking 3x8 inch fir, double diagonal studding 8x12 inch fir, spaced 36 inches apart.

Engine and thrust seating, extra fir keelsons 20x20 to be fitted in way of engine and thrust foundation, also for for taking boiler saddles.

Gun foundations on forecastle head and on after deck house.

Fastenings according to classification, masts Oregon pine.

Boats. There will be: Two 22 ft. x 6 ft. 6 in. x 2 ft. 9 in. metallic lifeboats. One working boat of wood, 16 x 5 by 2 ft. 3 in.

Steam heating will be provided throughout living quarters.

Terms of Government Contracts.

The figures at which contracts have been awarded have been withheld from publication. The announcement of the Emergency Fleet Corporation that in the future contracts will be let on a lump sum basis only is a tacit admission that a few of the first contracts were let on the basis of cost plus a per cent. This method is manifestly unfair since it puts a premium upon expensive and wasteful methods.

Contracts have been let and will be let for either the complete hull ready for machinery or the complete ship ready for sea. Of the 88 vessels contracted for so far only 8 contracts have provided for the hull only. The contractor agrees to take no other work which will interfere with or delay the vessel.

The contract is in its terms very fair and liberal. No bond is required from the builder who is also protected from expensive arbitrary alterations in the plans. The government will not exact a total penalty of more than $25,000 per vessel for delay in delivery and payments have been so arranged as to practically finance the construction.

Each completed vessel will be paid for as follows: (a) Ten per cent 10% within thirty days after signing contract; (b) 10% of contract price when keel is laid and ¼ of the framing timber is in contractors' yards; (c) 10% when all square frames are in place; (d) 10% when center and sister keelsons are in place, cant-frames erected and stem and stern post up; (e) 10% when ceiled to 'tween deck and the lower deck clamps are in; (f) 10% when ceiled to upper deck, all clamps and shelf streaks and both lower and upper deck beams are in; (g) 10% when steamer is planked to the main decks and waterways are in place; (h) 10% when fully planked, decks laid, and the decks and the outside of the steamer entirely caulked; (i) 10% when steamer is successfully launched and on delivery to and acceptance by the owner.

A bonus of $300 per day will be paid to the builder for every day when delivery is made in advance of contracted time, and there is a forfeiture of $300 per day for every day exceeding contract date of delivery, but the total premium on liquidated damages is not to exceed $25,000 for any one steamer.

If the contractor materially fails to carry out the provisions of contract and shall continue in default for 60 days after notice thereof to the owner or inspectors, the owner shall have power to enter into and take possession of said steamers and allow the contractor a reasonable rent for his yard and facilities until the vessel or vessels are completed by the owner.

The latest amendments to the specifications will convert about $30,000 of material and equipment to owner's account.

Timber schedules and specifications have been prepared for the information and guidance of lumber manufacturers and contractors both East and West, detailing specifically and in full the material and dimensions of same. These schedules, arranged alphabetically, will be of the greatest assistance in speeding up.

NEW SHIPYARD FOR LIBBY.

Libby, McNeill & Libby have just purchased a block of land on Lake Union, Seattle, to be used as a shipyard and a terminal for its salmon fleet. Lake Union will be formally connected to Puget Sound, July 4th, when the Lake Washington canal is thrown open.

AMERICAN BUREAU OF SHIPPING.

Better known as the American Lloyds, the American Bureau of Shipping will establish offices in Seattle with a staff of surveyors to take charge of the work on the Pacific Coast. Capt. J. F. Blain, Northwestern Representative for the Federal Shipping Board, has been appointed chief ship and engineering surveyor for the Bureau, whose office address will be Securities Bldg., Seattle, Wash.

TRACTION MAGNATE VISITS SEATTLE.

Dwight P. Robinson, of Boston, member of the Stone & Webster company, visited Seattle recently for the purpose of completing arrangements for an extensive ship yard on Harbor Island, Seattle, where, it is reported, they will construct a large number of wooden motorships for the Federal Board.

EASTERN ENGINEER JOINS CANADIAN SHIPBUILDING CO.

Wm. N. Howell, formerly connected with the Patterson-Allen Engineering Co. of New York, is now associated with the Davis Shipbuilding Co. of Lauz-on-Levis, Quebec, Canada.

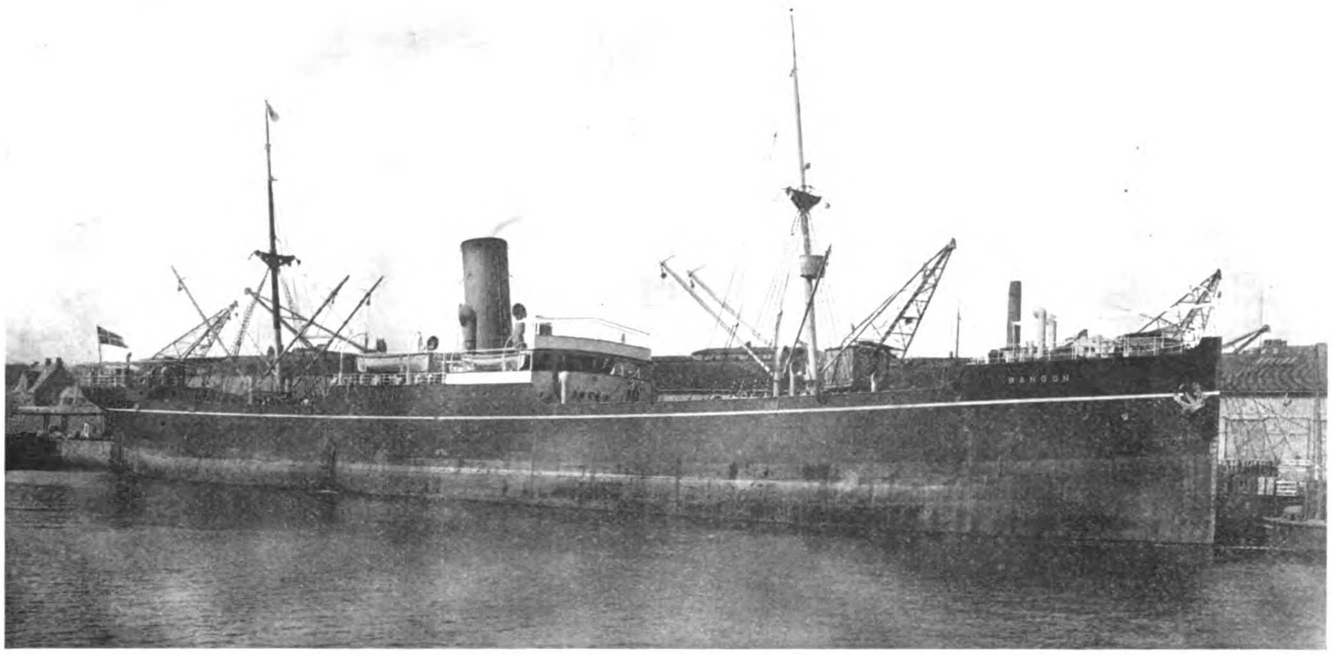
COLUMBIA BRONZE CORPORATION.

The Columbia Brass Foundry, famous for propellers, was merged with the Columbia Bronze Corporation May 21st, and hereafter all business will be conducted under the name of Columbia Bronze Corporation.

PIONEER SHIPBUILDERS INCORPORATE.

The Nilson & Kelez Shipbuilding Company of Seattle was incorporated May 22nd for $200,000, with A. S. Nilson, N. M. Kelez, John Erickson, Daniel Johansen and R. P. Oldham as incorporators. Both Messrs. Nilson and Kelez are well-known Puget Sound shipbuilders and played an important role in the construction of the motorship "Oregon."

Conversion of Three Steamships to Motor Power



STEAMSHIP "BANDON," NOW FITTED WITH BURMEISTER & WAIN DIESEL TYPE ENGINES

CONVERTING at a single stroke three 6,000-ton steamers to Diesel oil-engine-power was a bold action; but faint heart never produced radical economies. This was a step taken some little time ago by the East Asiatic company, and now they are reaping the results of the wisdom of their action, for the three ships can now together carry 2,400 tons more cargo per voyage than they previously could handle, and their fuel bills have been reduced to about one-fourth of what they previously were. With fuel and cargo at their present abnormal prices the total economy that the change means to the owners today must run into well over half-a-million dollars annually, which amount warrants at least investigation on the part of American steamship owners.

We refer to their three single-screw coal-burning freighters, "Bandon," "Pangan," and "Chumpon," which, in accordance with their policy to operate only Diesel-driven motorships, they had converted from steam to motor power, the work on the three sister-ships having been carried out practically at the same time.

The "Bandon," which we illustrate, is quite handsome for a cargo-ship, and her smoke-stack has been retained for the purpose of emitting the exhaust-gases and the smoke from the donkey-boilers; but the absence of a steam-exhaust pipe on the stack will be apparent to the close observer. This stack is even of greater diameter than we are accustomed to in America and gives the effect of stolidity to the vessel. She is a steel-built craft, constructed in 1909 by Barclay, Curle & Co., of Glasgow, to whom was entrusted the task of converting her to Diesel motor power. She was in New York quite recently. The following are her original dimensions:

Length	330′ 1″
Beam	47′ 3″
Depth	25′ 7″
Carrying Capacity	6,000 tons
*Gross Tonnage	3,409 tons
*Underdeck Tonnage	3,102 tons
*Net Tonnage	2,183 tons
Power	2,000 i. h. p.
Speed of Engine	68-70 r. p. m.

Note—*These three may be her present measurement.

The reciprocating steam-engine and boilers were removed and were replaced by a six-cylinder 26 3/10″x29⅜″ four-cycle class, single-acting, direct-reversible Burmeister & Wain Diesel-type engine of 1,700 i. h. p. at 110 r. p. m., which is equivalent to about 1,500 steam i. h. p., or say, 1300 shaft-horse-power. Exactly why this lower power was installed there is no means of ascertaining just now; but the speed of the ship consequently was reduced a little, although the actual difference is not large. Probably the average speed for the year will work out nearly the same as previously, because the revolutions of a good Diesel oil-engine are even and steady throughout a voyage in storm and calm, instead of fluctuating according to the inclinations or efforts of the firemen in the stokehold. For the same reason a motorship and a steamship making the same acceptance trial speeds will show different results in actual operation, and the motorship will maintain a better average for the year's running because her propeller speed will be more constant. Few shipowners know of this fact!

This change of machinery produced an actual increase of 800 tons in the cargo-capacity, because, although a fuel-bunker capacity of 600 tons is retained, the reserve bunkers of 400 tons aft of the engine-room and 200 tons in each side not needed with economical motor power, so formed a distinct gain in cargo space; also the amount of space required by the machinery and the weight both were reduced, although these particular Diesel engines happen to be heavier than those of some other makes. Hence, her present carrying capacity is 6,800 tons—a distinct gain! The present bunker capacity is sufficient for 75 days under full power, as the daily consumption at sea including auxiliaries is only 8 tons, compared with the previous consumption of 28 tons per day. Of this eight tons the main engine uses 5¾ tons, the donkey-boilers 2 tons, and the auxiliary motor about ¼ ton. For a time Taraken fuel—a Borneo crude-oil—was used, but the writer is not aware if this heavy-oil still is the fuel. There also must have been a boiler-water weight saving. The 600 tons of oil-fuel now carried must be sufficient for a voyage roughly 16,200 nautical miles.

It will be understood that while the gains effected made the conversion well worth while, by no means so economical or satisfactory a job could be obtained as with a ship specially designed to take oil-engines. For instance, the main boilers were removed, but two oil-fired donkey-boilers were fitted in order to operate the existing steam auxiliary machinery, such as pumps, winches and steering gear, and these donkey-boilers use about one-third as much fuel as the main propelling engine. In view of the fact that donkey-boilers had to be fitted, it is rather curious that the owners did not order boilers with a specially large surface-area to one of them. Then they could have utilized the exhaust-gases from the main Diesel engine to fire it when at sea, and thus save at least seven barrels of oil per diem. The mean temperature of the exhaust-gases is about 700-800 degrees Fahr. There also is in the engine-room a 100 b. h. p. Diesel-driven auxiliary air-compressor, which is used for 200 to 300 hours per voyage.

The original engine and boiler crew consisted of 14 men, but this has been reduced in the case of the motorship to eight men (five engineers and three greasers). Some troubles were experienced when the "Bandon" first went into operation, but the weak features of the design were quickly found out, and various changes and replacements to the marine Diesel engine were made accordingly. These were chiefly due to faulty piston-cooling arrangements, which caused cracks, etc. All troubles, I understand, now have been overcome, and that all three ships are giving excellent service.

The main advantages gained by the conversion may be enumerated as follows:

1. Gain of 800 tons cargo-capacity.
2. Great reduction in fuel-bill.
3. Reduced engine-room staff.
4. Absence of stoker worries.
5. Absence of standby charges in port.

Apart from the last three advantages let us see what the first two economies should result in if she was in service in American waters. Without knowledge of the prices previously paid by the owners for fuel, and the freight-rates obtained, it is not possible to correctly ascertain the exact economy effected, but we can fairly accurately estimate the savings and gains at today's rates and prices; and thus reasonably ascertain what the alteration to the "Bandon" means today to the owners' pockets.

If at sea 238 days in the year, or, say, eight round voyages of 31 days each, with cargo-rates averaging $25 per ton, the gain in cargo-capacity would mean approximately $20,000 per voyage, or $160,000 per annum.

In addition to this we have the saving of 20 tons of coal (ie daily coal-consumption was 28 tons) per day at $7 per ton. As exact figures are tons of coal (the daily coal-consumption was 28 This figures out at $4,340 per voyage, or $34,720 per annum. There also is a saving of fuel when in port. Hence, the total economy effected and gains made must be about:

$194,720.00 per annum per ship.

As three ships were converted the grand total saving to the East Asiatic Co. today must be about:

$584,160.00 per annum.

It is unfortunate that no definite figures are available; but we have endeavored to be as conservative as is compatible; and we have not included the standby savings, or the reduction in wages and in food-bills effected by the absence of stokers.

"WM. E. BURNHAM" TO BE POWERED.

Her owners having yielded to the temptation of a profitable charter, the "Wm. E. Burnham" recently purchased in the East by the Pacific Lime Co., of Vancouver, B. C., has left New York and is coming to the Pacific coast under sail instead of waiting to have engines installed as was planned. Accordingly the engines will be shipped to the coast and the installation made here at an early date, consisting of twin 150 h. p. type C. O. Fairbanks-Morse oil engines with direct reversing gear and electric instantaneous-starting device. The vessel is a three-masted schooner, practically new, and is expected to arrive within the month.

Developing a Marine Diesel Engine

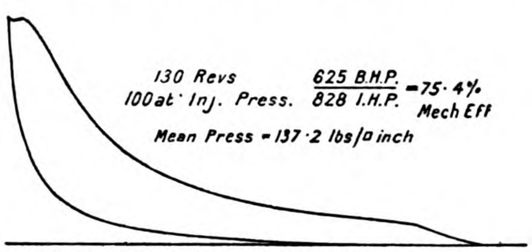
If accurate figures regarding the cost of the development of the marine Diesel-type engine in the Eastern Hemisphere could be obtained, the amassed totals would run into tens of millions of dollars. In some instances complete engines, or complete cylinder units, were built, tested, and placed on the scrap-heap without even seeing the hull of a ship, and fresh designs made, by some of the great European shipbuilders and marine engineers, without the slightest conjunction. Quite contrasting development methods were adopted by different companies. Some worked in conjunction with shipowners on the basis that Diesel engines were to be designed, built, and given reasonable shop-tests and then to be installed in ships, the owners participating in the risk. This, with the idea that faults could best be discovered at sea under normal operating conditions, and that such was the best method, even if losses were made on the running of such experimental ships. The only real fault of this method was, that it resulted in outside steam shipowners condemning the entire Diesel system, because of the repairs and alterations that had to be made to such motorships.

Neither builders or owners of experimental motorships had anticipated that the daily press and semi-technical journalists would fall head-over-heels to make wonderful claims for these pioneer craft by turning the designers' hopes into accomplished facts, which in itself only succeeded in giving steamship owners a distorted view of the situation, from which they never have properly recovered. In one or two instances it is true that exaggerated claims were made by certain Diesel builders—some rashly—others for financial purposes; but, they since have fully paid for their misguided steps by the will of a power greater than that of man.

Other builders decided to take upon themselves all the heavy burden of the development together with its enormous cost, and when these firms found from several years of test-bed results, that they were not fully satisfied, they did not hesitate to scrap the engines, discard the designs, and start anew in different directions. Such actions needed considerable courage, and were highly commendable, especially four or five years ago, when no one had attained complete success; but today they are unnecessary, for Diesel designs now can be obtained that have proven to be practical and thoroughly dependable for the severe usages of ocean-going work, the developers of which generously have offered the benefit of their experiences to the world.

Messrs. Wm. Doxford & Sons, Ltd., of Sunderland, England, is one of the concerns that decided to do their own developing, and when, after two years' hard work, they found that the engine thus produced was not free from faults and not so satisfactory as those of other makes, they boldly swallowed the cost and started anew, building a Diesel engine on entirely different lines, having properly recognized that it was not the Diesel principle that necessitated this action, but that their design did not properly meet the peculiar requirements of the Diesel principle.

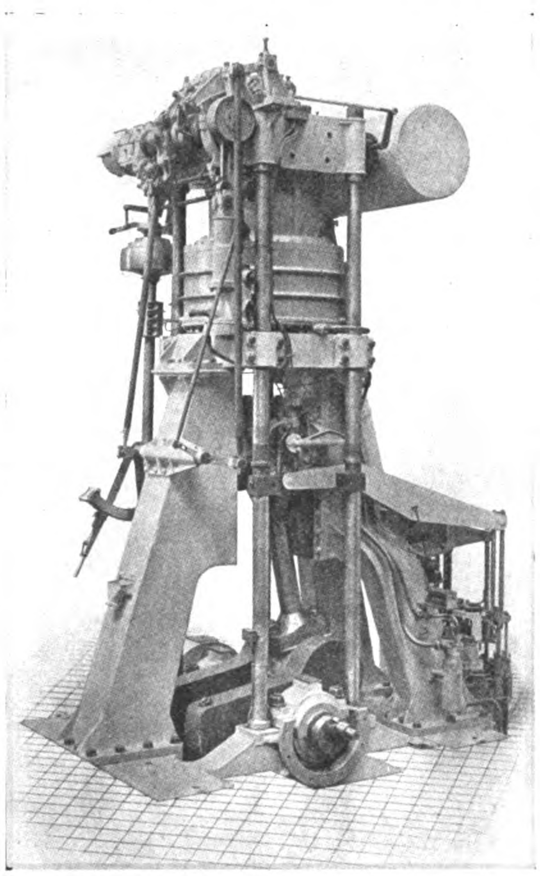
It was in 1910 that Doxford first decided to commence marine Diesel engine construction, and, at



CARD FROM DOXFORD DIESEL ENGINE.

that time they did not recognize that what was needed to facilitate the production of a successful design was a combination of stationary Diesel-engine and marine steam-engine experiences. They possessed the marine steam-engine knowledge, but lacked the other essential factor. However, nearly two years test-bed operation of their first unit gave them what was almost an equivalent of a certain amount of stationary Diesel practice, consequently their second attempt resulted in a tremendous improvement, although perfection has not yet been assured, sea-going tests having been suspended by conditions of war.

Their first attempt was one-cylinder of a two-cycle type motor, designed to develop 1,000 brake-horse-power from four cylinders at 130 revo-



DEMONSTRATION DOXFORD MOTOR BUILT IN 1910

lutions per minute. This single-cylinder unit has a bore of 19 7/10 ins. and a stroke of 36 ins. It was of the stepped-piston type, with valve-in-the-head scavenging, the stepped cylinder being mounted on an A-frame and supported by steel columns, or rods, running from the bed-plate to the cylinder-head, the air-compressors and water and pumps being beam-lever driven by ordinary beam levers. No European assistance was called in for this work, their own staff having accomplished all the designing. The cylinder compression used was 500 lbs. per sq. inch, and the indicated mean-effective-pressure was 120 lbs.

Extensive experiments proved to their conviction that this design of engine, while it gave more than its designed power, did not offer that wide margin of reliability so essential for merchant-ship propulsion. There was nothing radical about the design or construction, in fact the illustration will show its simplicity and marine steam-engine practices were the key-note of the engine. Yet they found that the repairs that sometimes become necessary even during shop-trials were beyond the usual facilities aboard ship.

Furthermore, they decided that the detachable cylinder-head, being an intricate casting by reason of the presence of scavenging-valves, fuel-valves, starting-valve, and safety-valve, was subject to unascertainable stresses of manufacture, pressure, and heat transmission. Particularly the scavenging-valves, which required too much attention (and many engineers do not consider port scavenging efficient, apart from other difficulties which port scavenging with large single-acting marine engines set up). Finally, they found it difficult to distribute the heavy load on the piston over the main bearings, also almost impossible to maintain a film of oil over the journals with a reasonable consumption of lubricant. In the latter feature they are not alone, as every other maker of large single-acting marine Diesel-type engines has had the same difficulty, and to this day the difficulty has not been overcome, even by increasing the size of bearings a little out of proportion to the size of the engine.

The outcome of these combined difficulties decided Messrs. Doxford that they had not the confidence necessary to allow such engines to be installed in ships, and that, however disappointing it was to discontinue the experiments, it was better to use the valuable data and experiments thus gained for producing a design of marine oil engine having no cylinder-head and little or no load on its main bearings.

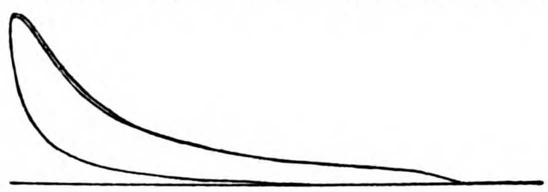
Doxfords decided that the Oeschelhauser opposed-piston engine met this ideal, and they were not alone in this conclusion, for at that time the Weser Co., of Bremen, and the Frerichs Co., of Osterholtz-Scharmbeck, were running trials of some large marine sets of similar design, which they had built in conjunction with Professor Junkers, and under Junkers patents. The failure of the Weser-Junkers and the Frerichs-Junkers marine engines is now a matter of past history, yet at the time many marine engineers believed that the ordinary Diesel-type engine—particularly the four-cycle—would be ousted by the Junkers opposed-piston oil engine. Incidentally I may mention that Chief-Engineer Cole, who is writing that excellent series of articles in Motorship, was to have been the Chief-Engineer of a motorship that the Frerichs Co. built for Lane & Macandrew of London, and he studied the engines in the shops for some months before they were refused by the owners after unsatisfactory test-bed trials.

Before commencing this article I raised the question of the failure of the Weser and Frerichs engines with Messrs. Doxford, who intimated that these failures did not come as a surprise to them after they had seen the constructions and designs at the respective works, and that the said results must be taken as indicating the inherent defects in the opposed-piston principle.

At the same time I cannot yet feel assured that Doxfords have actually overcome all the weaknesses of the opposed-piston construction, for it was local temperatures that caused fracture of the cylinders of the Frerichs engine. The cylinders of the same were even in thickness except at the center, where bosses were required for the fuel-injection and air-starting valves. The bosses coming exactly where the temperature is highest caused unequal expansion and the cylinders split from top to bottom, necessitating the shrinking-on of steel bands to prevent breaking of the cylinders. Also cylinders of the engine of the "Arthur von Gwinner" cracked at sea. Apparently the lengthy and severe shop tests of the Doxford engine revealed no such tendency, and possibly the design of cylinder and liner that they have produced may have such influences fully allowed for.

Agreeing that the thirty-two days' shop trial given by Doxfords to their new opposed-piston engine was in itself very severe, too much confidence must not be placed upon it, for shop-trials in skilled hands do not anyway approach the severity of 40, 44 and 60 days continuous operation at sea in indifferent hands, which motorships have to and actually have accomplished on more than one occasion.

With every working-surface clean and true, clearances set just right; all joints tight; every

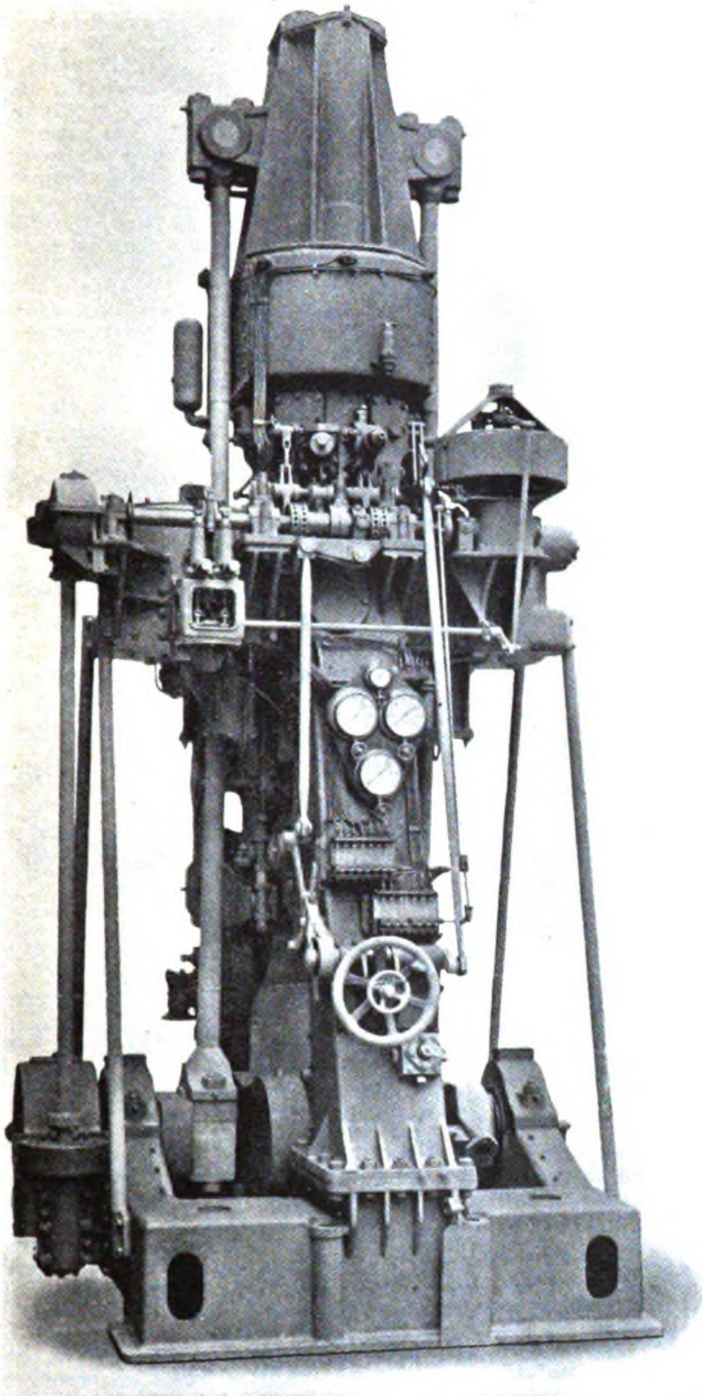


Indicator card taken from Doxford engine when running on Mexican fuel oil with sp. qr. 0·95. The mean indicated pressure (from the card) is 8·4 k.g. per sq. c.m., or 119 lbs. per sq. in. 660 i.h.p.: 505 b.h.p.: 77 per cent. efficiency · 120 r.m.p 105 atmospheres air pressure.

bolt and nut firm; all pipes, ducts, passages and spaces free and clear; with clean, fresh water for cooling, everything lined-up, balanced and adjusted by skilled men; and with plenty of skilled mechanics in attendance,—mechanics who have watched the engine grow from the first casting—it is only natural for an engine to show splendid results.

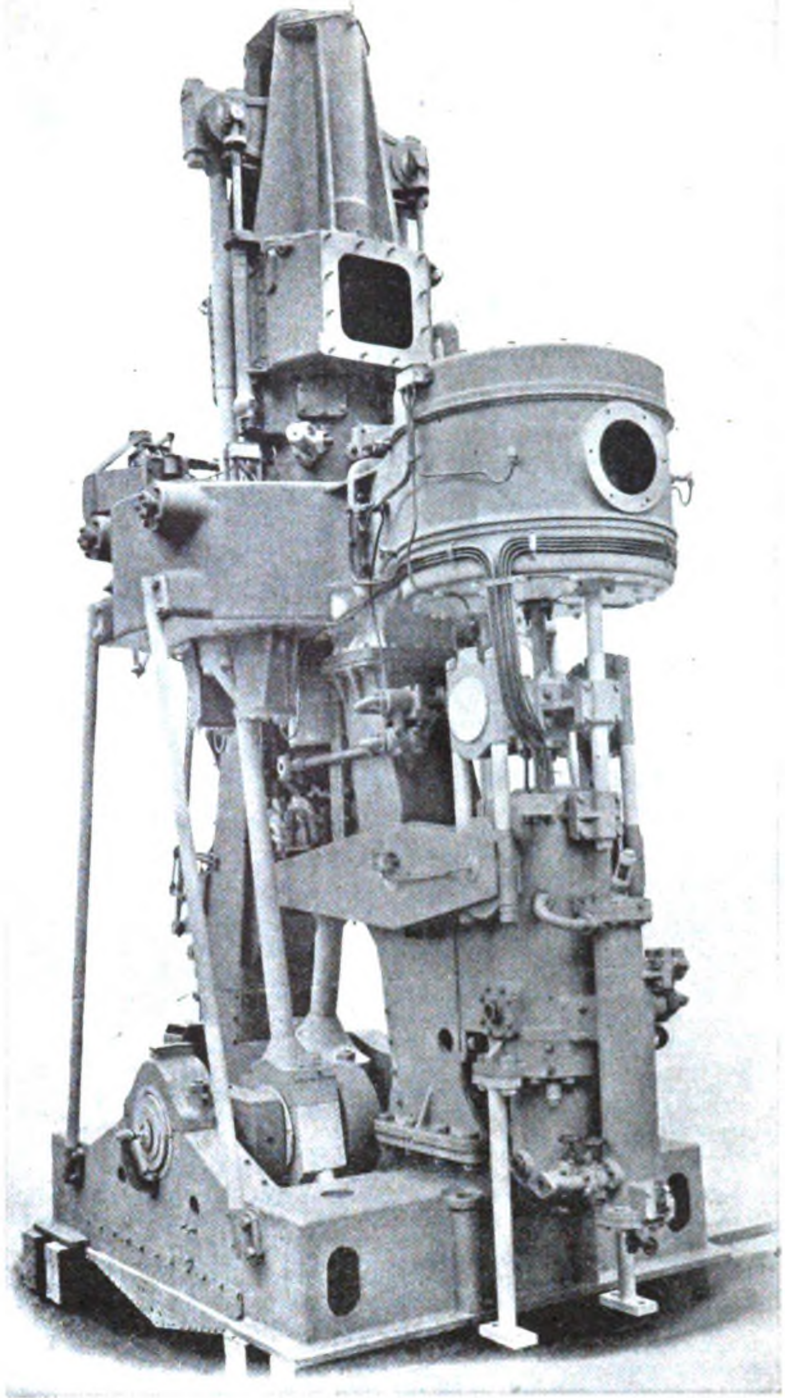
But placing absolute dependence upon such results is a policy that is questionable, especially as it afterwards may boomerang on to the builder. For, when the engine is in operation at sea or at the dock, with only one watch on duty,—perhaps a couple of careless or indifferent assistant-engineers, who may have been drafted from a steamer, consequently only slightly familiar with crude-oil engines, dust and dirt may wear the working surfaces, packing will burn; bolts and nuts might work loose, settling and strains of the hull sometimes causes parts to get out of line and out of balance; pipes, ducts, or oil feeds will choke and clog; water-cooling passages become impeded with deposit; oil may be foul because of improper cleaning of filters; not altogether, but singly, and by two's and three's, upsetting the designers' most careful calculations.

For some of these things the owners must make allowances, and thus co-operate with and assist the builder, for they occur with any marine steam-engine, and is not a fault akin only to the oil-motor. But all the same it demonstrates that sea



Front view

DOXFORD OPPOSED-PISTON OIL ENGINE



Back view

experience is necessary to produce, thoroughly test, and prove, a successful high-powered marine Diesel-type engine.

However, in order to ascertain what effect a partial stoppage of the cooling-water would have on the cylinder and liner, the jacket and piston cooling water of the Doxford engine was raised from the normal temperature of 160-170 degrees to 200 degrees Fahr. for several hours, and the speed was raised to 150 r. p. m., yet no signs of overstress or detrimental effects on the liners or pistons were given, which tends to prove that the cylinder design must be a great improvement over that built by Frerichs, because the ordinary shop tests did reveal the weaknesses of that design.

As yet I have not mentioned the size of the opposed-piston engine built by Doxfords. Its cylinder diameter was the same as that of the first engine, namely 500 m. (19 7/10 ins.), but as each piston has a stroke of 29½ ins. the total stroke is 59 ins., the old engine also having a bore of 19 7/10 ins. by 37-in. stroke. Now, the old engine gave only 350 indicated-horse-power, or about 250 b. h. p. at 130 r. p. m.; while, with the opposed-piston engine of the same cylinder bore actually gave 700 b. h. p. for 12 continuous hours on a 50% overload, although the power averaged on the five weeks' run was 470 b. h. p. at 112 r. p. m. It will be realized that so far as power is concerned a tremendous development had been made, particularly as the ground floor occupied by the bed-plate in both cases is exactly identical, while the height of the new engine is only 18 ins. more, measuring from the centre of the crank-shaft.

From an engine of four-cylinders of this size Doxfords intended a rating of 1,800 b. h. p. at 130 r. p. m.; but it will be seen that from the results of this single cylinder the continued output would mean this power at lower speed, or a possible maximum overload power of 2,800 b. h. p. It is easy to imagine what this would mean to a twin-screw ship, normally of 3,600 shaft h. p.; but which could develop 5,600 shaft h. p. several hours if chased by a submarine. Such a tremendous increase of power would practically be impossible with steam machinery.

In view of these results it is no wonder that Doxfords have advised us that after the war they will be prepared to build marine oil-engines up to 3,000 b. h. p. at 70 r. p. m. per engine. But, I cannot refrain from uttering a warning note to this estimable firm to proceed very cautiously with such high-powered units, and first gain complete sea-going experience with a twin-screw set of about 2,000 combined b. h. p., or even less. I have seen far too many sad results of over-confidences since the first ocean-going Diesel motorship was completed seven years ago, and we would like Messrs. Doxford to attain at the start the complete success that their splendid progress deserves.

As yet I have made no reference to the opposed-piston methods of operation. It is not new, even to America, because the Wisconsin Motor Manufacturing Co., of Milwaukee, have built a small marine set on this principle, while the General Electric Co., of Schenectady have produced a stationary electric-generating set. The A. E. G., of Germany, also have successfully used the principle for stationary and marine work, while for years the Golbron-Brille automobile has been driven by a gasoline motor of the opposed-piston type.

At the same time there are quite a number of people who are not familiar with the system, so perhaps it will be well for me to lay out a brief outline of the cycle. It is essentially a two cycle engine, because exhaust and inlet valves would eliminate all the advantages pertaining to this peculiar design.

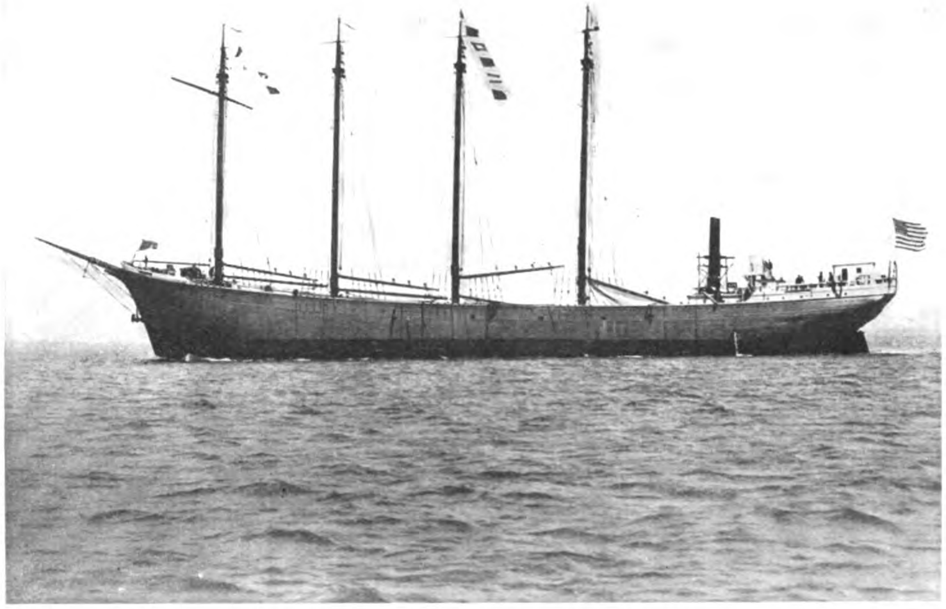
The lower piston has its piston-rod, connecting-rod and crank just as usual; the upper piston in the same cylinder simultaneously works in the opposite direction and has its piston-rod projecting upwards to what is called a compensating arm placed in a fore-and-aft direction. From the ends of this arm two rods lead downwards, one on each side of the cylinder, each to its own connecting-rod, which is attached to a crank opposite to the central crank of the lower piston. The combustion space is thus bounded by the cylinder walls and the heads of the two pistons instead of a piston and a cylinder cover, and the fuel valves are placed horizontolly in the side of the cylinder. In other words combustion occurs between two pistons and forces them apart. The exhaust gases escape through ports in the top end of the cylinder uncovered by the upper piston, while the scavenging air is admitted through corresponding, though shorter, ports in the bottom of the cylinder uncovered by the other piston.

The following are some of the advantages and disadvantages:

Advantages.	Disadvantages.
1. Absence of cylinder heads or detachable heads.	1. Cooling of upper piston rendered difficult.
2. Elimination of exhaust and scavenging-air valves and their operating gear.	2. Extra piston per cylinder needed with its attendant cooling arrangements.
3. Scavenging almost equal to that of a four-cycle engine.	3. An extra guide per cylinder.
4. No longitudinal stress in cylinder due to transmission of power.	4. Two extra side connecting rods and their cranks.
5. Increased power for cylinder bore.	5. Higher cost of crank-shaft.
6. Cylinder walls or liners comparatively thin.	6. Lack of accessibility for feeling parts when engine is running.
7. Lubrication of bearings facilitated.	7. Does not dispense with heavy scavenging-pumps.

Probably it will be obvious that satisfactory piston-cooling of the opposed-piston engine is

Motor Auxiliary Runs Off Trials



AUXILIARY MOTOR SCHOONER "S. I. ALLARD"

THE auxiliary motor schooner "S. I. Allard," owned by the McCormick Steamship company of San Francisco, ran off her trials very successfully over a measured course at San Francisco, April 26, 1917, between the hours of 11 a. m. and 4 p. m. Her average speed for the five hours was 9.63 miles per hour. With the tide she maintained a speed of 11.8 miles and against the tide she made an average of 7.93 miles. On this trip as on subsequent voyages the kind of fuel used was "Calol" of the Standard Oil company. Her rate of fuel consumption was not ascertained.

Capt. S. C. Mitchell was the officer in charge and the working of the engines was closely watched by Mr. W. R. Hewitt, the marine representative for the owners who declared was entirely satisfactory.

After these trials she made a run up the coast to St.Helens. During this trip she ran into an 80 mile gale and was driven 175 miles off shore. Notwithstanding this and the fact that she carried no ballast the trip was made in 6½ days. The vessel is now on her maiden voyage laden with a cargo of mining timber, bound forAustralia.

A description of the "S. I. Allard" and an account of the launching, which took place February 29, 1917, from the yards of the St. Helens Shipbuilding Co., St. Helens, Oregon, were given in a recent issue of "Motorship."

The "St. Helens," practically a sister ship of the "S. I. Allard," is to be launched from the same yards and for the same company about June 25th. She is two feet deeper in the hold than her sister ship.

quite a serious matter, particularly that of the upper piston, in fact I much doubt if they will ever dare risk using sea-water for this purpose, although sea-water has been used quite safely in ocean-going practice with many four-cycle Diesel engines. If this turns out to be the case it will be a little drawback, because of the necessity of carrying fresh water for that purpose, and thus using valuable cargo space. Salt water can be used if the supply arrangement is good, because when the water is below 100 degrees Fahr. practically no scale is deposited, and when below 75 degs. it is as good as fresh water, but it must not be allowed to drip, or splash, on to the moving parts, or mix with the lubricating oil.

The lower piston of the Doxford engine is cooled by a hollow rocking-arm on the crosshead, this arrangement being excellent, it only giving quite a small amount of rotary movement in the gland, so that packing should last quite a while; but, its construction is not cheap because of the fairly heavy parts required to ensure of good water passages.

For the upper pistons they have utilized telescopic tubes; but, in sea-going practice with over a dozen ships fitted with Diesel engines of other designs, telescopic tubes undoubtedly proved both unreliable and wasteful of water—and fresh water is valuable aboard ship. Certainly glands can be made tight without stopping the engine; but there is a limit on the amount of tightening that can be done. In the various cases referred to telescopic-pipes of steel were fastened to the bottom of the pistons, working into larger sized outer-pipes through stuffing-boxes and glands. These steel pipes corroded very quickly with the action of the sea-water and it was impossible to keep the glands tight and avoid leakage. They were replaced by pipes of brass which worked fairly well, but these broke off at the neck frequently. This fracturing was due to the fact that while the pipes could be set quite straight by the fitters when erecting, or testing, the engines in the shops, it was not so easy in the ship, when the engineers had removed the pistons for inspection or cleaning purposes. Consequently these pipes, when replaced, would be out-of-line with their glands, and the unequal frictional side-pressure quickly broke them, or caused the stuffing-boxes to wear the tubes on one side, and result in a leaky gland. Should salt water be used on the upper piston of the Doxford engine, one can easily understand the resultant effect of the action of the water on the working parts below. On the other hand, if salt water is not used it will be a drawback, and so I should not be at all surprised to see the designers make a change before long, and use some new device, or else the rocker-arm method now used with the lower piston.

On the trials in the Doxford shop this telescopic-tube mechanism did occasionally leak badly, one to the extent of a slight spurt of water that was thrown beyond the trough. At one time an ordinary pipe joint blew out, and another time a pipe cracked at the band round the gland. During the 5 weeks' trial the glands were tightened up at least half-a-dozen times, which will show that my remarks are fully justified, and a reoccurrence of such a leakage aboard ship would be detrimental to the engine builders, whereas the leaking referred to is not in the least disparaging, because it took place during the shop trials, where such weaknesses are expected to become apparent. The water temperature at the outlet from the upper piston was 170 deg. Fahr., which is rather high, it entering at 130 deg. Fahr.

With the opposed-piston design, conditions in the combustion-chamber are somewhat different to those in an ordinary Diesel-type cylinder, due to the high-piston speed (1,101 1/3 feet per minute at 112 r. p. m.). Hence, arrangements have to be made to get combustion well under way in a much shorter time than with the ordinary single piston engine. This is effected by the use of a much higher blast-air pressure than the normal, and by an earlier fuel admission. This early fuel admission does not cause any raising of the compression pressure above 600 lbs., so far as can be judged from indicator cards taken with the phase altered so that the combustion is shown in the middle of the diagram, though the fuel-valve is certainly open at such a point that one might reasonably have expected such a rise in compression to occur. Perhaps I should make it clear that the form of the cam is different from the usual, in that there are two steps; the first is cut to a circle struck from a radius which exceeds by a minute fraction the radius of the cam clearance circle, so that the roller comes very gently into contact; this first part leads directly into the ordinary rise and gives the normal full lift to the valve for complete combustion. The injection-air recorded was as high as 1,300 lbs. per sq. inch. One Diesel engine, that I know of, has a cylinder compression of 410 lbs. per sq. inch and an injection-air of 852.6 lbs. when the indicator shows a mean pressure of 101.3 lbs; so that the difference is enormous.

On the Doxford five weeks' shop trial a Mexican fuel-oil of the following analysis was used:

Specific gravity 0.910
Flash point ....175 degs. Fahr.
Viscosity ....120 seconds
Calorific value ....19,110 B. T. U.

The total duration of the test was 35 days 14 hrs. 47 min., of which stops occupied a total of 2 days 17 hrs. 8 min., leaving 32 days 21 hrs. 29 min. net running time; but none of the stops were due to reasons strictly resultant from the Diesel principle, but were mostly ordinary mishaps that will occur to any mechanical device, and from little details with which the designers had had no previous experience. These I will deal with presently. The following are some readings taken during the test:

Revs. P. M.	B. H. P.	I. H. P.	Mean Effective Pressure, Lbs.	Mechanical Efficiency, Per Cent	Fuel Consumed, Lbs. per H.H.P. Hr.	Fuel Consumed, Lbs. per I.H.P. Hr.
114.1	479	623	119	77	0.438	0.336
113.0	474	643	124	74	0.430	0.319
111.8	469	...	119	....	0.418	.....
130.0	...	828	137.2	75.4	0.507	.....

The first record was over a duration of 7 hours, the second over a period of 9 hours, and the third over a period of 5½ hours. The fourth is an overload test of 35% with blast-air of 100 atmospheres. Lubricating oil averaged about 1¼ gallons per hour, which is very good indeed. I already have referred to the fact that the maximum overload was about 40 per cent, apparently this was limited by the size of the fuel-pump, which could not pump more oil into the cylinder. A larger fuel-pump since has been installed, and when further tests are carried out the builders hope to get between 60 and 70 percent overload, which would mean 800 b. h. p. from a single cylinder of only 19 7/10th inches diameter, which certainly is remarkable; but, of course, this power could not be utilized in ordinary sea-going practice, except in the event of a most extreme emergency.

The stoppages during the trials were caused by the following:

(1) Relief-valve leak after first week's running, due to being burned. It had a flat face with a thin lip, and the latter got burned away. The faulty design was altered and the trouble eliminated.

(2) Pipe joint of upper piston water-cooling system blew out, due to wrong packing material used.

(3) Pipe of same supply system cracked at bend.

(4) Starting valve leaked after two weeks running due to becoming burned. More clearances then were given to the guide and the trouble was over.

(5) Another joint in the water service gave out.

(6) Hot fly-wheel bearing probably due to heavier fly-wheel being used than that to be fitted aboard ship.

(7) A hot top-end brass, due to a steel ball-valve, in the little pump lubricating this bearing, having become corroded by the action of acids in the lubricating oil; hence the pump gave no oil and the pin ran hot. This stop lasted 37 hours. The brass was re-bored, and a mitre-valve fitted in place of the ball, and that trouble was over.

(8) Next was a breakage of another pipe, this being the oil-pipe that led the lubricant into the center of the forward end of the crankshaft, and apparently it had been fitted out of truth or too stiffly. The new pipe was given greater freedom, and was satisfactory.

(9) Lastly, and towards the end of the trial, a lubricator on the oscillatory arm of the lower-piston water-cooling device came off. This was quite a minor matter; but when the engine was re-started the relief-valve lifted every stroke, and it was seen that the spindle was bent. Apparently this was due to the spring having got hot

and softened when the relief-valve originally leaked. In screwing it down hard, a collar on the spindle was screwed home on the guide, thus bending the spindle. A new spindle of higher tensile steel consequently was fitted.

A study of the foregoing will convince any engineer of sound common sense that none of these mishaps were otherwise than such as may, and do, occur with any steam job under ordinary conditions; but in the case of the Diesel engine they are hardly likely to re-occur, because the cause has been remedied.

After the trial everything was overhauled, and for the most part the entire engine was in splendid condition. The pistons were free and clear except that the tops were covered with a thin coating of lime, and over this a thin film of carbon, and otherwise quite free from deposit or burns. With the Doxford engine the fuel when injected does not strike directly on to the piston-tops, which perhaps is a good thing because of the unusually high injection air-pressure used, but is blown horizontally across the piston surface, for which the designers claim considerable advantages.

Lastly, the whole of the combustion space, is surrounded with water, whereas with the single-piston engine, with two exceptions, the flanges of the cylinder and cylinder heads, prevent the cooling water from reaching just the hottest part of the walls, not only causing unequal expansion at this part, but the temperature is higher, lubrication is more difficult, causing greater wear, and carbonized lubricating-oil more easily develops. Hence, the Doxford design has much to commend it, and I hope that similar success will attend their engine when installed in ocean-going mercantile ships. Messrs. Doxford fully deserve it, their attitude having shown progress combined with reasonable conservatism and cautiousness.

T. O. L.

THE JUNKERS ENGINE.

A MOST interesting paper on the Junkers opposed-piston Diesel-type engine was read by Mr. Philip Lane Scott before the Society of Automotive Engineers in New York on May 17th. Mr. Scott spent last year (1916) in the laboratory of Professor Junkers at Aachen, Germany, and had the opportunity of studying this design first hand. The matter is specially interesting because of the article in this issue on the Doxford engine, which was commenced under Junkers' license.

One of the most remarkable developments of this motor has been an aeroplane engine which developed 200 h. p. at 1,000 r. p. m. on directly injected kerosene, without the use of electrical ignition, the combustion heat being obtained entirely by compression and on the Diesel cycle. There were four cylinders lying horizontally with a crankshaft at each end and no side connecting-rod. The crankshafts were held in proper relation by gearing at one end, and the propeller was driven by an intermediate gear in this train. No great difficulty with scavenging at high-speed, says Mr. Scott, has been encountered.

Mr. Scott also mentions that some 450 h. p. tandem horizontal engines, turning at 90 r. p. m., are operating some shallow draft boats on the Donau river. Another of the illustrations accompanying the paper depicted a freight and passenger vessel using the horizontal type of engine. In the five years that this engine has been running, trouble due to unequal wear has not appeared and the cylinders have not been changed. In spite of the fact that this engine has an excessively heavy bedplate, that the flywheel is twice as heavy as is necessary for marine work, and also that it is a slow speed machine (180 r. p. m.), the weight is but 57 kg. (125 lbs.) per b. h. p. including flywheel.

The piston displacement per unit of time, says Mr. Scott, is one of the best means of comparing the capacities of engines, but it is very seldom used. The knowledge of the number of volumetric units displaced per minute to produce a certain output gives one a basis of comparison that it is impossible to misconstrue and indicates readily what the general operating conditions are.

Mr. Scott also discussed the use of tar-oil as fuel, and his remarks are of appreciable value. Tar oil is little known in America as a Diesel engine fuel, but it is the most difficult fuel to burn properly, though hardly more viscous than water and containing no asphalt. The burning of oils having a high asphalt content is not very difficult, although combustion must be perfect in order to avoid the heavy pitch-like substance that slowly collects on the pistons and prevents lubrication.

Tar oil is a mixture of the three fractions next to the last, pitch, in the distillation of coal tar. It is dark brown in color, a little heavier than water (specific gravity 1.040 to 1.150) and contains a hydrocarbon very similar to carbolic acid in structure, which gives the oil a corrosive action on metal and makes a strong irritant on the skin. Its use in Germany was becoming a necessity, owing to the scarcity of crude-oil distillates.

Perhaps because its hydrocarbons belong to the benzol ring and not to the benzine chain, this oil is excessively tenacious of its chemical energy, and as compared with crude oil distillates, requires an immense amount of heat to start oxidation. Once the reaction has commenced, however, it has a tendency to burn explosively. Greater initial temperature is necessary for tar oil to start combustion, but, because of its tendency to burn explosively, this is an undesirable feature the moment combustion begins. It was not an easy problem, but it was solved eventually and the engine can be started cold (16 deg. C.) with tar oil.

Because of the very high compression (about 700 lbs. per sq. in. compared with 420 to 500 lbs. with most Diesel-type engines) in the Junkers engine the temperature in the combustion space is much higher and the pistons become and are allowed to remain considerably warmer than is the usual practice. The oil is sprayed into the cylinder in two fans, one directly across the face of each piston when they are at the inner dead center. The high heat capacity of the iron promotes warming of the oil far more readily than air, aiding the initial combustion. But as soon as the pistons recede they draw with them the thin layer of burnt gases formed by the initial combustion and lying between the piston head and the oil spray. The hot metal then exerts no influence on the oil, and two oil layers inclose the hot compressed air and retard the explosive effect.

Since injection of fuel takes place during from 30 to 40 deg. of the crank circle, the oil spray is relieved of this too intense heating necessary to initial combustion during the greater part of the injection period. In a single-piston engine this would be impossible, since, if the fuel valve is vertical, the oil strikes the piston continuously during the injection; if the valve is horizontal, the fuel spray always remains in close proximity to the cylinder head.

AMERICAN STEAMSHIP VERSUS MOTORSHIP "BENGKALIS."

Some Interesting Comparisons by New York Shipowners.

THE publication in the May issue of Motorship of the operating costs of the Diesel-driven motorship "Bengkalis" caused considerable comment among shipowners, because of her remarkable economy, and one well-known New York firm of shipowners evinced sufficient interest to work out comparisons with one of their steamers of nearly the same size that they have in operation between United States, Mexican and Cuban ports. These details we have pleasure in reproducing, they having been furnished by the owners, who are very well known, but whose name we withhold by request.

They take for the purpose of comparison their only oil-fired steamship; but have only used her as a basis upon which to plan out the operating costs, because she is a little larger than the "Bengkalis."

Assuming, they write, a motorship similar to the M. S. "Bengkalis" was registered under the American flag and operated on the same basis as an oil-fuel burner of the S. S. "Blank" class, the comparative cost of operation to an oil-burner of proportionate dimensions would be approximately:

	Motorship.	Oil-Burner
One month's wages of crew..	$1,425	$1,630
Say 4,000 miles steaming on round trip, fuel at $1.50 per barrel	330 (220)	2,520 (1,680)
	$1,755	$4,150
		1,755
		$2,395

showing a monthly net saving on wage and fuel accounts alone of $2,394 in favor of the motorship. The ratio of actual cargo capacity to deadweight shows the motorship is about 88% and the oil-burner 80%. There would also be a saving in victualling of $1.00 per man per day. As the motorship requires only 17 men compared with the oil burner's 21, this alone would make a net saving of $4.00 per day, $120.00 per month, or $1,440.00 per annum.

Roughly, on the items of wages, victualling and fuel alone, for a year's operation, they write, a saving of $30,000.00 would be effected, which is well worth considering, where such a small ship is concerned.

The dimensions, etc., of the two ships are as follows:

	S. S. "Blank"	S. S. "Bengkalis"
Length	239' 0"	230' 0"
Breadth	38' 0"	38' 0"
Loaded draft (S. F.)........	15' 6"	11' 0"
Displacement (loaded)	3,050 tons	2,000 tons
Dead-weight capacity.........	2,000 tons	1,240 tons
Actual cargo capacity (fuel tanks full)	1,600 tons	1,100 tons
Bunker capacity	2,200 barrels	742 barrels
Maximum cruising radius	5,000 naut. mi.	10,000 naut.mi.
Speed (loaded)	8 knots	8 knots
Speed (light)	9 knots	8½ knots
Daily fuel consumption (24 hours)	84 barrels	10½ barrels
Normal power of engines......	700 steam i.h.p.	600 Diesel i.h.p.
Type of engines	Recip. steam	4-cycle Diesel
No. of cylinders	3	6
Cylinder bore	16"x25"x42"	15¾"
Cylinder stroke	33"	27¾"
Engine speed (normal)	92 r.p.m.	170 r.p.m.
No. of engine-room and boiler crews	10	7
Single or twin screws......	Single	Single

It will be noticed that although the displacement of the S. S. "Blank" is 1,050 tons greater than that of the M. S. "Bengkalis", she can only carry 500 tons more cargo; so that, had the motorship been of the same dimensions as the "Blank" she would have carried about 600 tons of cargo more than does the steamer; that is to say, about 1,000 tons more than she (the "Bengkalis") now actually carries on her smaller dimensions. The motorship also carries 12 passengers which, however, need not be taken into consideration now.

Now it is obvious that because of the diversity of capacities, (which are due to the economy of the motorship) it is difficult to properly compare the operating expenses, so they have assumed that the S. S. "Blank" is of the same overall dimensions as the M. S. "Bengkalis," which would produce the following approximate results. On the return trip both ships carry more cargo because of the percentage of fuel consumed.

Motorship.

Downward trip (fuel tanks full) capacity....	1100 tons cargo
10 days steaming at 10½ bbls. (105 bbls)....	15 tons fuel
Upward trip capacity	1115 tons cargo

Oil-Burner.

Downward trip (fuel tanks full)	1000 tons cargo
10 days steaming at 85 bbls. per day (850 bbls.)	121 tons fuel
Upward trip capacity	1121 tons cargo

Motorship.	Oil-Burner.
1100 tons	1000 tons
1115 tons	1121 tons
2215 tons	2121 tons
2121 tons	
94	

94 tons greater earning capacity of motorship per voyage. Approximately eight voyages (West Indies and Mexico) per year would mean a greater earning power of 752 tons at say $14.00 per ton

Average	$10,528
Add: Saving in wages, fuel and victualling	30,000
Annual saving on motorship	$40,528

Owing to these comparatively short trips the full fuel economy of the motorship and its effect on the cargo capacity has not been taken into consideration. Were the ships engaged in a trans-Atlantic voyage and full bunkers had to be carried the economy of the motorship would be much greater because she has double the cruising radius on one-third the quantity of fuel, hence the space available for cargo would be much greater.

Returning again to the S. S. "Blank" it is interesting to see how her wage bill compares with that of the M. S. "Bengkalis", assuming, of course, that both are operating under the American flag, and that neither carry passengers or the necessary staff for passengers.

Crew and Wage List.

		M. S. "Bengkalis"	SS. "Blank"
Captain	$200	$200	$200
1st mate	125	125	125
2nd mate	115	115	115
3rd mate	110	110	110
Seamen (4)	45	180	180
Chief engineer	150	150	150
1st asst.	110	110	110
2nd asst.	100	100	100
3rd asst.	90	90	90
Oilers	55	110 (2)	165 (3)
Cook	75	75	75
Galleyman	30	30	30
Waiter	30	30	30
Firemen	50	..	150 (3)
Total monthly wages		$1425	$1630
Total crew		17	21

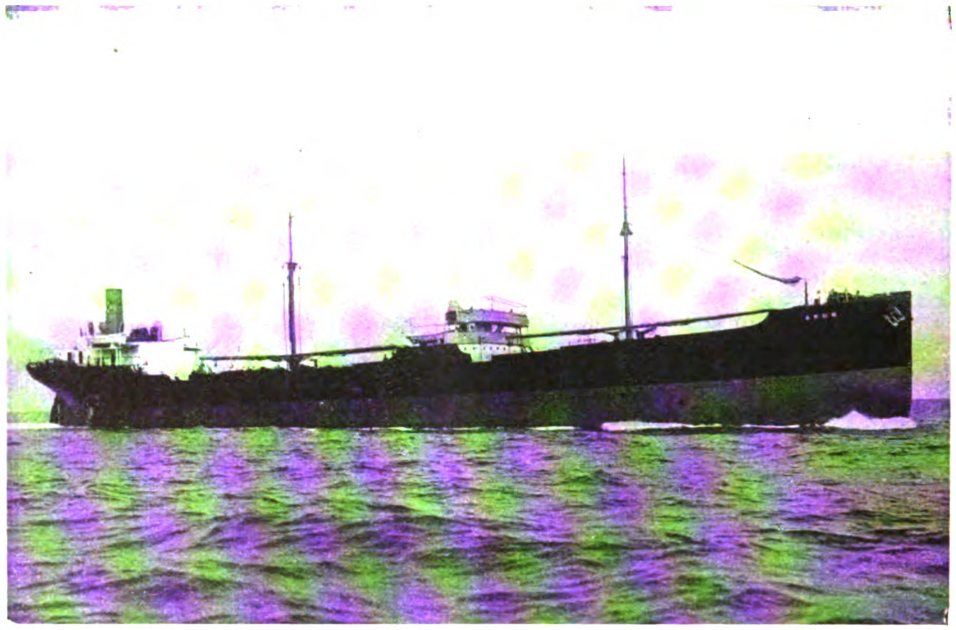
Hence, there is an additional saving of $2,460.00 per year, without taking into consideration the reduced cost of the annual food bill. But, a wise policy would be to take all this wage-money saved and give it to the engineers as a recompense for having learned all about the motors. Then the ship would never be detained in port for want of engineers.

The Neptune Marine Diesel Engine

An Interesting British Design Based On the Swedish Polar-Diesel Motor

ONE of the first companies to undertake the construction of marine Diesel engines was the A. B. Diesels Motorer of Stockholm, who, in 1903, completed a couple of 120 b. h. p. four-cycle-type motors for the Volga tanker "Wandal" at the request of Nobels, the great Russian oil magnates, and I believe that Ludwig Nobel furnished the design. Since that date the Swedish concern has installed two-cycle-type Polar-Diesel engines of their own design in about 60 small coastwise and sea-going craft of from 80 b. h. p. up to about 400 b. h. p. per boat, and in two large high-powered ocean-going vessels, namely the "Sebastian" and the "Hamlet," the latter ranking as one of the highest-powered commercial motorships in service. Several years ago the Polar-Diesel concern granted a number of constructional licenses, including to the Benz Co., of Mannheim, Germany, to Swan, Hunter & Wigham Richardson, Ltd., of Neptune Works, Newcastle-on-Tyne, England, and to the McIntosh & Seymour Corporation, Auburn, N. Y., U. S. A.

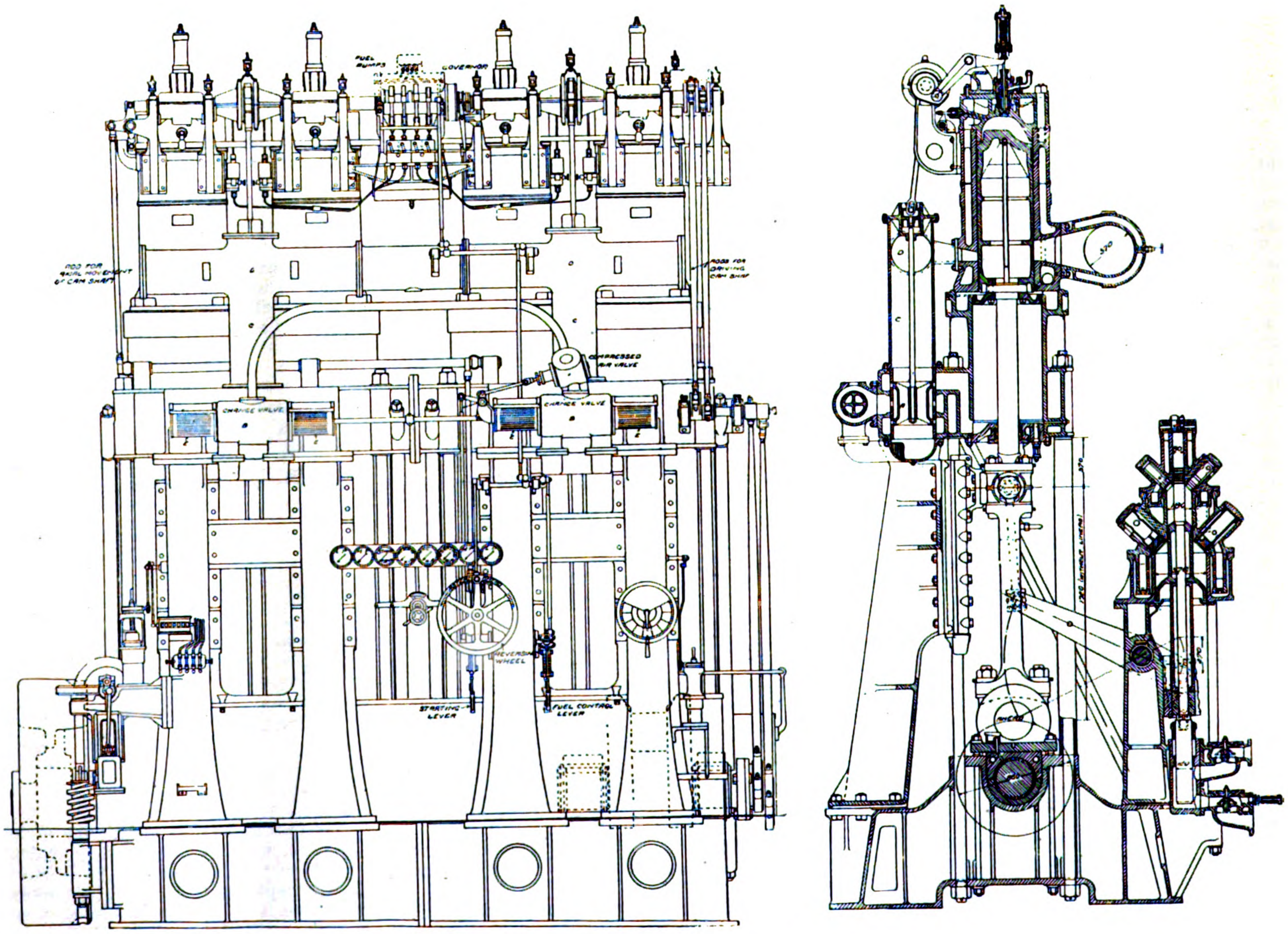
It is strange, but nevertheless a fact, that when most ship and engine builders who have adopted a Diesel-motor constructional-license are concerned, no sooner have they purchased experience and drawings, they set about slightly altering the design to their own ideas, or even make radical departures from the license-granters' designs. Let us take several typical cases. The New London Ship & Engine Co. are now building to their own design, although for several years they built to Nürnburg drawings. The McIntosh & Seymour Corporation are constructing four-cycle type engines, whereas all the Swedish Polar mercantile marine Diesel motors operate on the two-cycle principle, but in this case the Swedes made this four-cycle design for them. The U. S. Navy Department made a number of modifications from the original Nürnburg designs of the "Maumee's" engines. Blohm & Voss made considerable departures from the M. A. N. designs. Schneider & Co. made radical changes from the original Carels drawings, as did other Carels licensees, such as the Reiherstieg Co., and Vickers, Ltd. Finally there are the engines that I am now about to describe.



MOTORSHIP "ARUM," FITTED WITH NEPTUNE DIESEL ENGINES

In the vessels "Toiler" and "Calgary," Swan, Hunter & Wigham Richardson installed Diesel engines which practically were duplicates of sets built at Stockholm, but for later and larger ships such as the "Arum," "Arabis" and "Aramis" they have constructed an engine of their own design, which, although based on the earlier Polar design, and on the design of the "Sebastian's" engines, is quite distinctive in many ways, and embodies quite a number of features not contained in the Polar models.

Whether, or not, a licensee is justified in departing from the licensor's design largely depends upon circumstances, and in some cases the step is a wise one, while in others such action would be distinctly foolish. Where to draw the line is hard to define. In several instances the licensee is a marine steam-engine constructor of considerable experience and repute, and may have acquired a license from a concern building stationary Diesel engines purely for the internal combustion engine experience, and under these particular circumstances would show wisdom in introducing their own steam engine knowledge, because the licensor would not have proper acquaintance with the exact requirements of mercantile work. On the other hand if the licensor previously has had very extensive experience with large ocean-going Diesel-driven motorships the licensees probably would make a bad break if they departed from what it had heavily cost the licensor to learn. This would seem to be the



GENERAL ARRANGEMENT AND SECTIONAL VIEW 650 B. H. P. NEPTUNE DIESEL ENGINE, SIMILAR TO THE TWO INSTALLED IN M. S. "ARUM," SHOWN ABOVE

most logical aspect of the situation, and those entering into the construction of marine oil engines under license may do well to reflect thereupon.

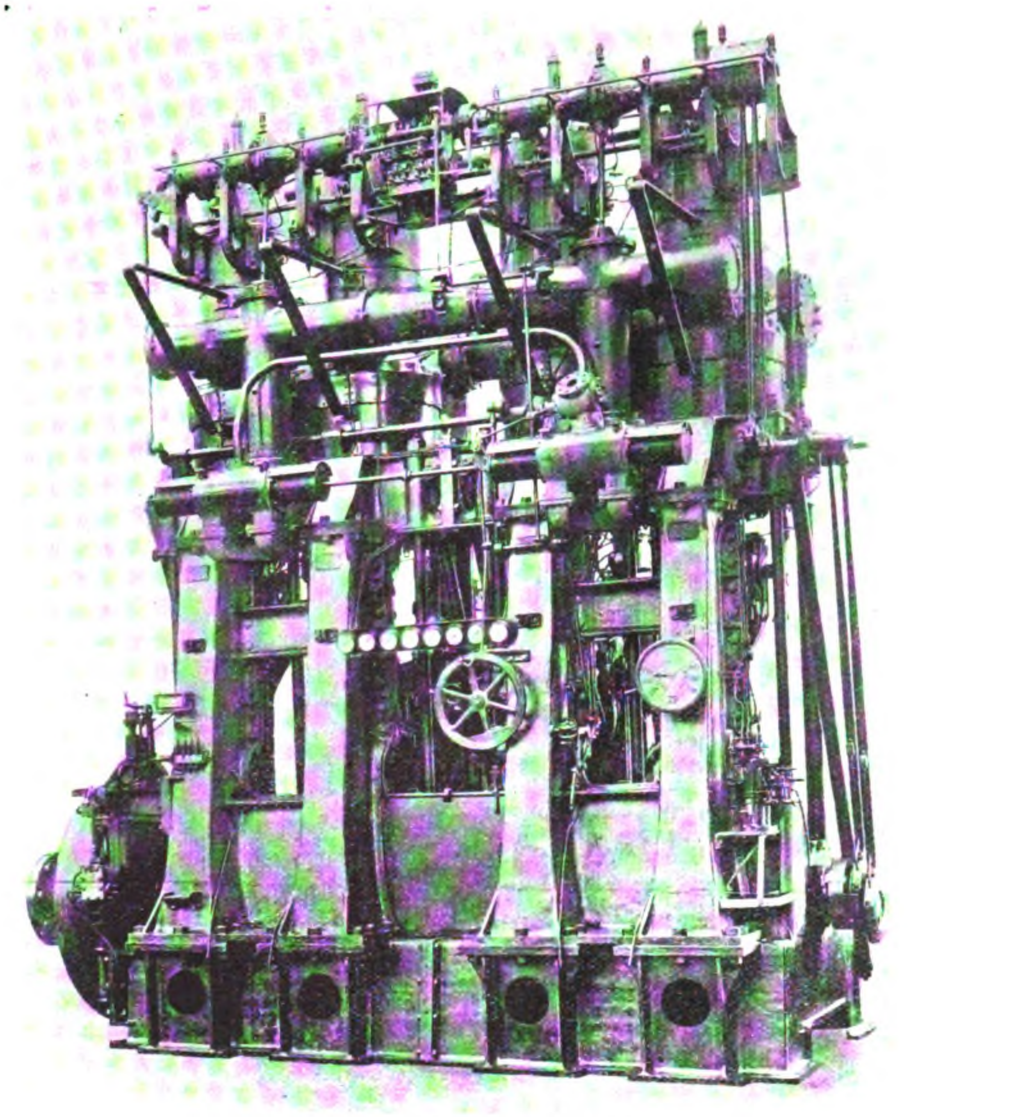
This policy evidently is one followed by Swan, Hunter & Wigham Richardson, Ltd., for, when they entered into the building of the large engines of the ships "Arum" and "Arabis" the Swedish company had not then completed the engines of the "Sebastian" and "Hamlet," which were of different design even to their own previously built Polar motors, consequently they had not then had ocean-going experience with high-powered Diesel engines, their work up to then covering engines of under 500 b. h. p. each, whereas the British firm were fully acquainted with high-powered marine reciprocating steam engines. Hence, they were justified in producing their own design, and this course has proven as excellent in practice as in theory, because the engines of the "Arum" and "Arabis" have been more successful than the original two in the "Sebastian" that were built at the Stockholm works.

In this article I will deal with one of the two Neptune engines of the "Aramis," which are now in the shops at Walker, near Newcastle-on-Tyne, and which virtually are the same in design as those in the sister ships "Arum" and Arabis," except for the minor modifications resultant from the experiences gained with those engines at sea under war conditions.

This engine is a four-cylinder model, single-acting, and direct-reversible of the two-stroke cycle principle, with the scavenging-cylinders arranged directly below the working-cylinders, so that the engine is of what is known as the step-piston class. The working-cylinders have a bore of 16⅛ ins. with 33⅞ ins. stroke, and in addition to the step-pistons the engine has regular marine crossheads, the guides for which are carried on cast-iron columns in front of the engine. On the trials 850 i. h. p. was developed at 123 revolutions per minute, or equivalent to about 750 steam i. h. p.; and, as the mechanical efficiency is about 78% the brake-horse-power developed is about 650, while the consumption of fuel oil is 0.46 to 0.48 per b. h. p. hour, or about 0.35 lbs. per i. h. p. hour. The engine is 16′ 0″ long by 20′ 0″ high above shaft center, and the piston speed is 690 ft. per minute. The mean-indicated-pressure is 102 lbs. per sq. inch, while the daily fuel consumption is approximately 3½ tons, or 23 barrels. The main bearings and crankpins have a diameter of 280 mm. (11 in.) The designed engine speed is 130 r. p. m.

Forged-steel columns at back and front, rise from the bedplate and support the scavenging-cylinders, which are separate castings from the working-cylinders, and diagonal rods absorb lateral stresses. These steel columns do not pass up to the working-cylinders or cylinder heads so do not directly absorb the forces of combustion, which forces have to pass through the studs holding down the detachable cylinder heads, and through the studs securing the working-cylinders to the scavenging-cylinders. As the cast-iron columns also are connected to the scavenging-cylinders I presume that some of the combustion stresses are taken up by them, but what effect the different expansions of the cast-iron and of the steel columns have in actual operation, but possibly the differences may not be so important in fact as in theory. In some designs where cast-iron columns are used to carry the crossheads and forged-steel columns to support the cylinders, the designers have not bolted the cast-iron columns to the cylinders, but have made the connecting surfaces a sliding fit, in order that an unequal expansion will not cause cracks. This, however, does not appear to have been done with the Neptune engine, because the drawings show a bolted connection. On the back of the engine are two pairs of separate cast-iron columns, on each pair of which is mounted a three-stage air-compressor, the cylinders being in tandem, with a triple-stepped-piston. These short cast-iron columns also form bearings for the fulcrums of the beam-levers operating the air-compressors.

There would appear to be no separate liner to the working-cylinders, the cylinder jacket being cast-integral with the cylinder proper. Water-cooling of the pistons is by sea-water through telescopic tubes, fitted with stuffing boxes and glands, and it would be interesting to know if this has proved satisfactory, because some builders have found that while telescopic-tubes may be excellent for stationary practice, or when testing engines in the shops, they are difficult to set accurately in line in a ship, when being replaced after the pistons have been removed for cleaning the rings, and when set out of truth causes wear at the glands, hence leakages and fractures. If



NEPTUNE MARINE DIESEL ENGINE
Front view

no trouble arise from the source the information will be valuable to engineers.

In the Neptune design, however, accurate re-setting of the telescopic tubes should be facilitated by taking measurements from the crosshead-guides, the telescopic-tubes not being attached to the pistons direct, but to the scavenging-cylinder casting, the water inlet and outlet being through the crosshead pin, thence through tubes set in the center of the piston rod. The inlet tube is in the center of the outlet tube and extends to the working-piston top, whereas the outlet tube only reaches to the bottom of the long working-piston. With this system the inside of the piston top should receive a constant stream of water, which immediately should drop to the bottom of the piston and flow away through the outlet tube. Possibly some of this water will be thrown back on to the piston top by the reciprocating motion of the piston before it can all flow away, thus producing an auxiliary spray of water, and so facilitate cooling. Air vessels are fitted in suitable places to prevent water hammer.

As is consistent with the Polar design port scavenging has been adopted, so that there only is one valve in the cylinder head, namely the fuel-injection valve, the rocker of which is operated off a cam-shaft mounted on the working-cylinder. In the side of the cylinder head is arranged a relief valve the usual blow-off pressure for which is about 1,200 lbs. per sq. inch. This valve can be opened by hand, a neat little trip device being fitted for the purpose.

The camshaft is actuated by means of rods and cranks somewhat similar to the arrangement first adopted with marine Diesel engines by a Dutch concern about six years ago, with the difference that the Neptune system is in two stages, so that each stage of these actuating rods is only half the length of the height of the engine instead of being as long as the engine is high. Furthermore, the cranks turn at engine-speed instead of half-speed, hence they are operated directly off the forward end of the engine crankshaft, instead of off a lay-shaft driven by two-to-one gearing, as in the case of the four-cycle engine of Dutch design just referred to. Also there are only two rods per stage, whereas the other motor has four rods. This crank-and-rod actuation gives very smooth and quiet action, and may be considered more satisfactory than vertical rod and toothed-gear drive, but is more expensive to construct.

In the case of the engines built at Stockholm the scavenging-cylinders are used as air-engines when starting or maneuvering, whereas with the Neptune design the scavenging-cylinders are used solely for scavenging, compressed-air being admitted to the working-cylinder for maneuvering. Apparently this would indicate that Swan, Hunter & Wigham Richardson regard the claim that "admission of cold air to the hot working-cylinders is detrimental to the metal" is a fallacy, and, if so, they are not alone in this belief. If admission of cold air was a serious matter, then water-cooling of the combustion chamber also would be detrimental, whereas in actual fact it is advisable to completely water cool the combustion chamber and cylinder head as is possible.

One of the special Swan-Hunter introductions in the design is the mechanism for controlling the admission and discharge of the scavenging air, which mechanism also controls the compressed air for starting and reversing.

The main parts of each set of valve gear consists of a piston-valve that controls the flow of scavenging-air, or the compressed air when maneuvering, through the ports in the cylinder walls, and a change-valve that serves to admit either the scavenging-air or the maneuvering-air as desired by the engineer-in-charge. This piston-valve is actuated by an eccentric on the camshaft, the eccentric being set, by an axial movement of the camshaft, to the required position for driving the engine ahead or astern as the case may be. Thus, the changing of the relative position of the cams on the camshaft and the setting of the eccentric for the valve gear are effected in a single movement.

One set of valve-gear is furnished for each pair of engine cylinders, the cranks of the two units being 180 degrees apart. Over the valve is an air-receiver consisting of a vertical pipe and a horizontal pipe from which the air passes to the working-cylinders. Air for scavenging is admitted through the ports in the working-cylinder wall, via the change valve, this air being supplied

under low pressure from the scavenging-pump of the adjacent cylinder, while compressed air for starting or reversing is admitted through the valve that can be seen above the change valve, a lever on the starting platform operating this mechanism. In order to diminish back-pressure, or exhaust-resistance, when starting on air, the change valve is so arranged that most of the air is exhausted through the ordinary air intake pipes.

Between the two pairs of cylinders, and driven by eccentrics off the camshaft, are four fuel-oil pumps, each working-cylinder of the engine having its own pump, a practice that has been adopted by the majority of engine builders, and is, in fact, an inheritance from stationary engine design. In this connection it may be mentioned that I understand aboard the "Arum" Persian fuel-oil was used successfully, and this contains a high percentage of sulphur and asphaltum.

T. O. L.

A FEW NOTES ON THE M. S. "KANGAROO."

An Article of Special Importance to Steamship Owners.

We frequently have dealt with the cargo-carrying-capacities of motorships of various sizes, because we cannot too strongly emphasize the importance of the great value of additional cargo-capacity compared with steamers of the same dimensions.

Many American shipowners operate steamers of approximately the same dimensions as the Diesel-driven motorship "Kangaroo," owned by the Government of Western Australia, which is a steel-built vessel of the following dimensions:

Length bet. perps.	365 ft.
Length over all	381 ft.
Breadth moulded	50 ft.
Depth moulded to upper deck	29 ft.
Loaded draught	23 ft. 4½ in.
Gross tonnage	4,348 tons
Net tonnage	2,777 tons
Displacement	6,640 tons

She is driven at an average speed of 10½ to 11 knots (11-2 on trials) by two British built Burmeister & Wain Diesel type oil engines of 1,125 i. h. p. each at 140 r. p. m. Shipowners will know just what the holds of a steamer of about the above dimensions will carry, so we need not give them here. The "Kangaroo," however, has the following capacity for cargo:

Cargo Capacities—	Cub. Ft., Grain.	Cub. Ft., Bales
Hold No. 1	41,640	39,430
Hold No. 2	107,530	102,650
Hold No. 3	40,830	38,830
Hold No. 4	24,520	22,840
Main 'tween decks	112,940	97,810
Total	327,460	301,560

From this it will be realized that she is a very remarkable cargo-carrier for her size, yet she by no means represents the motorship limit. Hence, a shipowner could afford to pay considerably more per ton d. w. c. for a similar motorship than for a steamer. What also is of interest is that she carries this huge cargo on an oil-fuel consumption, including auxiliaries at sea, of 0.292 lbs. per i. h. p. hour, or under 7¼ tons (about 50 barrels) per 24 hour day.

In addition to the foregoing cargo she carries in her double bottoms the following fuel-oil, which is sufficient for a voyage of over 26,000 nautical miles without refueling.

Tanks—	Bunker Oil Tanks. Tons at 38 C. F.	Water Ballast Tanks. Tons at 35 C. F.
Fore peak	..	50
Double-bottom tank No. 1	81	88
Double-bottom tank No. 2	164	178
Double-bottom tank No. 3	168	182
Double-bottom tank No. 4	120	130
Double-bottom tank No. 5	132	144
Double-bottom tank No. 6	44	48
Tanks in motor-room, after peak	105	52
Total	814	872

Lubricating-oil in double-bottom under motor-room equals 684 cub. ft. starboard. Lubricating-oil in double-bottom under motor-room equals 684 cub. ft., port. Total equals 1368 cub. ft.

Furthermore, this is not her sole earning-power and economy, for accommodation is provided for a number of first-class passengers. The entrances on the upper and bridge-decks are panelled and framed in American oak of natural color. The first-class saloon is arranged on the upper deck amidships. The walls are panelled and framed in mahogany, finished in flat white and relieved with gold, and with a polished mahogany dado. The room is decorated in the Adams style. The first-class smoke-room is arranged in a deck-house on the bridge-deck forward; it is framed and panelled in fumed oak, all in the Jacobean style. There are six suite-rooms arranged on the upper deck on the starboard side, with bath-room between each pair. Two single-berth staterooms are fitted on the bridge-deck next the entrance.

This vessel is in service so these figures are not fictitious. In this particular case we do not give any steamship comparison figures; but will leave it to shipowners to do their own comparison and the enormous saving to be effected will thus be silently, but forcibly, driven home. However, we will add that there is no steamship afloat that can compare in any economy way with the "Kangaroo."

S. A. E. SUMMER MEETING AT WASHINGTON.

Definite plans concerning the summer meeting of the Society of Automotive Engineers, to be held June 25 and 26, at the Bureau of Standards, Washington, were settled at the May meeting of the council of the society, which was held in the new S. A. E. offices in the Munsey building.

An informal dinner will be held in the banquet hall of the New Willard hotel (the headquarters of the society during the meeting) Tuesday evening, June 26. Secretary of War Newton Baker has accepted an invitation to be present and address the engineers. The other speakers have not been decided upon as yet. The dinner will be $6 per plate, and members are asked to make reservations through the New York office of the S. A. E.

The professional session on Tuesday, June 26, will be one of particular interest. The majority of the papers to be presented have already been decided upon and they all will be of a practical type.

The professional session will be held at the Bureau of Standards as will the Monday meeting of the Standards committee. Arrangements have been made with the bureau for the serving of luncheon each day on the lawn so that there will be little disturbance of the daily sessions, which are scheduled to begin at 10 o'clock and continue until 4:30 o'clock.

The motor-boat activities of the S. A. E. will be represented by Henry R. Sutphen, vice president of the Elco company who will give an illustrated talk on standardization methods and production plans used in building the 500 submarine chasers, which this country supplied to the British government. The illustrations will be in the form of three reels of moving-picture films, covering the complete scope of the work. The films will be accompanied by explanations by Mr. Sutphen.

BARNES & TIBBITTS INCORPORATE.

Captain W. G. Tibbitts, owner of the Pacific Shipyards and Ways at Alameda Point, Alameda, Cal., and J. D. Barnes, the well-known shipwright of 175 Stewart St., San Francisco, have organized a new shipbuilding concern and secured a large tract of land for the plant on the Oakland Estuary. The tract is on the Alameda side and extends from Grand Ave. to Chestnut St. There are about twenty acres in all, with a water frontage of 1320 feet. The company has been incorporated and the capital announced is $100,000. A large 360-foot wharf for landing supplies is being built and dredging on the water front has been commenced. The estuary will be dredged to a depth of twenty feet at low water, or 26 feet at high water, thus allowing for the launching of large vessels. Two sets of marine ways are under construction and material is arriving for the erection of the shipyard shops. A full equipment of wood working machinery has been ordered in the East and besides this the equipment of the old plant of the Pacific Shipyards will be moved to the new location. The old yards are located on the Southern Pacific lands west of Webster St. and all tenants have been ordered to vacate. For the present only contracts for wooden vessels will be taken, but in the future it is hoped that a steel plant may be in operation also. Mr. Barnes will still continue his business in San Francisco. Captain Tibbitts expects to receive government contracts for the construction of some of the wooden freighters of one design which the government has announced for early building. Together with other San Francisco shipbuilders he is holding himself in readiness to devote the full energies of his plant to government work if that becomes necessary. The officers of the new Barnes & Tibbitts Shipbuilding Co., which is the official name, are W. G. Tibbitts, president; J. D. Barnes, vice-president, and J. J. Barnes, secretary and manager. The main office for the present is 175 Stewart St., San Francisco.

DENMARK BUILDING MOTORSHIPS.

Consul General E. D. Winslow forwards the following from Copenhagen:

The building of wooden vessels is now under way in Denmark, and although the start is small the experiment will be pushed. The decision in this matter has been hastened by the submarine warfare of Germany. At many ports in Denmark temporary arrangements have been made for the laying down of wooden ships. Many industries are threatened with stoppage due to the lack of raw materials, and the workers can thus be given employment at the shipyards building these new vessels.

The type being constructed is a standard one, and having a loading capacity of 500 to 600 tons. These vessels will also be furnished with internal combustion engines. There are now building 10 of this style of craft.

DIRECTORS OF B. C. SHIPBUILDING.

Announcement was made by the imperial munitions board that R. P. Butchart, of Victoria, British Columbia, has been appointed director of shipbuilding for British Columbia to deal with all questions in connection with the building of wooden ships in the province. The Canadian Pacific railway has also released Captain J. W. Troop, manager of the British Columbia coast service of the Canadian Pacific railway, and he will act as assistant director and give the board the benefit of his experience and technical knowledge in connection with wooden shipbuilding.

The head office of Mr. Butchart and Captain Troop will be at Victoria, B. C., and all communications relating to wooden shipbuilding in that province should be addressed to them. Questions relating to wooden shipbuilding elsewhere than British Columbia should continue to be addressed to the imperial munitions board at Ottawa, Ontario, Canada.

JAPANESE OIL ENGINE EXPERIMENTS.

An interesting announcement is made by the Sale and Frazar Geppo of Tokyo to the effect that plans for a 10,000,000 yen scientific laboratory, to be a semi-official institution fully equipped with the necessary plants and men to assist in the development of various lines of industry are assuming definite shape in the hands of Baron Shibusawa and other government officials at Tokyo, the study of internal combustion engines being one of the chief subjects for research. It will be remembered that Baron Shibusawa visited the United States last fall and made an extensive tour for the purpose of collecting all data possible upon the design and construction of heavy oil engines.

"FLAGSTAFF" READY FOR SEA.

The five-masted schooner, "Flagstaff," built recently at the Hanlon yards of Oakland, has been turned over to the owners, the Western Fuel Co. This vessel was sold, while she was building, to Norwegian parties, but on account of war developments she was not allowed to be transferred to alien owners. The Norwegians had decided on the name "Falktind" for her, but upon regaining possession the fuel company changed the name to the "Flagstaff." The vessel was launched without a name, under the designation of No. 76. The original plans called for auxiliary power, but failing immediate delivery of her oil engines, she will make her maiden voyage under canvas.

MOTOR SCHOONER "MARIE."

The motor schooner "Marie," now owned by Swayne & Hoyt, San Francisco, has been overhauled at the Union Iron Works. This old vessel, which was built in England in 1876, is one of the oldest steel vessels to be powered with an internal combustion engine.

WOOD CO. ORDERS NEW MOTORSHIP.

The E. K. Wood Lumber Co. are so well satisfied with the efficiency of motorships in the lumber carrying trade that they have just contracted with the Mathews Ship Yard at Aberdeen for the building of another vessel of this type. The new vessel will be a twin-screw schooner, 170 feet over all, of 40-foot beam and light draft. She will be christened the "Lassen" and will be used for carrying lumber from the company's mills in Washington to the yards in Oakland.

Full-Powered Diesel Motorships, Their Economy and Future

By JOHN W. MORTON, M. E.

BEFORE the Diesel patent expired, we saw in the triple-expansion steam engine (with an efficiency of 14%) an overall efficient prime mover.

The Diesel-motor made it possible to obtain an efficiency of 38% to 40% and this figure of course surprised many a steamship company and coached them without hesitation to adopt this new economical prime mover for ship propulsion.

That time of course the fuel-oil could be gotten in large quantities and cheaper than present day's market prices, and which also accounts for the big boom in the motor industry in Europe (1912).

Oil at that time could be bought for 6-7 dollars a ton, but during the year 1915 on account of the war the price increased to about 19-21 dollars a ton, and this of course made the shipowners sceptical about the future advantages of the Diesel-oil engine, since the first full-powered motorships were made.

About the oil fields in the world, the U. S. A. ranks as No. 1, with Pennsylvania, Ohio and Texas, with average prices of $12 and $14 a ton.

In Mexico, especially around Tuxpam, several oil wells have been drilled, but the oil has a high percentage of asphalt and sulphur.

Without doubt California is the largest oil district in the world, the price then was about $7.00 a ton (1915), but the opening of the Panama Canal without doubt had something to do with the increase in price of fuel-oil, and which also was foreseen by some European companies (Burmeister & Wain, Copenhagen; Harland & Wolff, Belfast, etc.), and led to an incorporation to promote the shipping on the Pacific coast, also to establish fuel-oil bases on the main ship-lanes of the world, in order to promote and encourage the Diesel-oil-engine enterprise, the coming engine for all classes of ships within reasonable limits.

South Russia (Baku), Roumania, and Galicia's oil districts are not worth while considering for the large traffic. Galicia produces a very valuable crude oil, for which Germany is the most prominent buyer, and only the inner part of this country benefits by it, as the transportation to the coast would be too expensive. Roumania is only at the first stage of its oil-field development, and thus at this time not worth much.

The Russian oil is not so suitable for the Diesel-motor, moreover, Russia has a big fleet of Diesel-motor propelled cargo ships on the rivers and lakes, so a great export of oil from this country can not be expected. In East Asia we find a great amount of hydrocarbons available, which shipowners (especially The East-Asiatic Co., Copenhagen) have foreseen long ago by contracting for their oil supply for a certain number of years. As known, the above company (see Motorship for Jan, 1917, and later) ranks foremost among the world's Diesel-motor-ship operators, all ships being powered with the well-known Burmeister & Wain 4-cycle-type Diesel-motors, the first successful one of which they bought being the "Selandia." This company (Burmeister & Wain) have so far done much to bring the Diesel-motor over its "infantile paralysis."

After the harvested experience, any crude oil is not suitable for the Diesel-motor.

Rieppel came, during his experiments over fluid-oil, to the conclusion that good gas-oils and paraffins could be used to good advantage, but that all tar-oils and some fluid-hydro-carbons with a fuel value of 160.00 b. t. u.'s and slight trace of asphalt, could not be used under ordinary conditions.

The last year, though, has shown great progress. We can now employ oils, with a content of asphalt not over 26% and sulphur not over 2% though shall they at 40° F. still be in a fluid condition, and free from water and solid matter, and contain a small percentage of ash.

In table No. 1 is shown some of most prominent fuel-oils and their characteristics. Crude oil is not sufficiently clean to be employed as fuel-oil in its original condition, but its distillates, which evaporate at about 300° F. to 600° F. can be used satisfactorily provided the asphalt and sulphur content is low.

Of German hydro-carbons the distillate from "Braun-kohl-tar" is applicable by the so-called "dry" distillation of tar. On account of its high percentage of paraffin, it makes a high inflammable gas, when a pressure of 33-35 atm. is employed.

The combustion of "stein-kohl"-tar-oil is more difficult because this oil has a small percentage of hydro-carbon. This is overcome by mixing it with 5 to 10% lighter high inflammable oil or preheating it.

TABLE OF CERTAIN PROMINENT FUEL OILS AND THEIR CHARACTERISTICS

Oils	Spec. Gravity	Viscosity	Flashpoint °F.	Freezing Point	Analysis Distillation in % 482° to 572°	572° to 662°	662° to 752°	B. T. U.s per 1 lb.	Elementary Analysis C¹ %	H² %	S³ %	H 6x12	Ash.	Application
Gasoil (Galicia)	.87	....	260°	5° F. (hard)	23	62	12	18,000	85.6	12.7	0.6	1.78	0.00	Good
Gasoil (Roumania)	.89 .95	14.9 at 68° F. 15.5 at 122°	190°	5° (thin)	39.9	6.3	12.9	16,200	87.1	12.1	0.2	1.665	0.00	Good
Diesel-oil (Russia) Baku	.....	2.4 at 212°	280°	5° (about hard)	39.7	1.3	17.5	17,600	87.5	11.3	0.4	1.55	0.81	Bad
Texas oil	.892	....	187°	1° (liquid state)	31	3.1	56.3	17,600	86.7	11.6	1.1	1.605	0.00	Good
Mexican oil	.... .929	77.2 at 68° 11.0 at 122° 2.3 at 212°	97°	32° (thick)	11.5	49.5	Bal. thick liquid state	17,600	84.2	11.4	3.6	1.62	1.58	Bad
Braun-kohl-tar-oil	..... .887	1.35 at 68° 0.48 at 212°	205°	5° (liquid state)	41	11	.....	17,600	86.2	11.3	0.8	1.57	0.00	Good
German-coal oil	1.006	....	164°	30° (hard)	58	24	15	16,200	87.2	7.6	0.2	1.04	1.50	Fairly
Limit-values	0.94	2.1 at 176°	150°	....	....	....	Bal. 27	17,600	....	....	2.0	1.55	....	

C¹=Carbon; H²=Hydrogen; S¹=Sulphur. TABLE No. 1.

In the lower row (table No. 1) are listed "limit values" which at least can be demanded of oils for use in a Diesel-motor.

A lower flash-point than 150° F. should not be allowed as explosive gases are liable to form, and this must be avoided.

Practical considerations dictate that the freezing point should not be higher than 40° F., but the oil storage tank should be provided with oil heaters to ensure perfect flow to the fuel pumps at all temperatures.

The fuel value should not lie under 16,000 b. t. u.'s and the sulphur contents not over 2%.

Good fuel oil should show a high content of hydro-carbon.

Practical experience shows that the quotient

$$\frac{H}{C} \times 12 = 1.55$$

Below (Table No. 2) is shown some facts regarding the running and operation of motorships in service. The comparison is between the S. S. "Saltburn" and the M. S. "Eavestone," both of the

TABLE No. 2.

	S. S. "Saltburn"	M. S. "Eavestone"
Net reg. tons	1,097	1,105
Gross reg. tons	1,768	1,780
Weight of ship and engine, tons	1,280	1,260
Capacity, tons	3,080	3,100
Capacity of cargo hold, cub. ft.	151,500	158,000
Coal bunkers, tons	380	......
Oil tanks	......	156
Cyl. diam., inches—		
Triple-expansions-engine	20-33-54	20-stroke
Four-cyl. Diesel-motor	......	36
R. P. M.	62	95
No. donkey-boilers	1	2

"Furnes" line, which company investigated the economical side of motorships compared to steamships, everything else being equal. From a voyage with these ships the following data shows speed and fuel consumption (Table No. 3):

TABLE No. 3.

	Mean Speed	Fuel-oil Consumption
Steam-ship—Port Talbot-Algier	8.7 knots	12 tons coal
Motor-ship—Hartlepool-Barcelona	8.66 knots	3.95 tons oil

The ratio of fuel consumption is as follows:

$$\frac{M.\,S.}{S.\,S.} = \frac{3.95}{12} = \frac{1}{3.04}$$

And if coal consumption for the motorship's auxiliary boilers (for steering engine, etc.), which can be put as 0.65 tons and equal to 0.21 tons of oil, is taken into consideration, we have:

$$\frac{M.\,S.}{S.\,S.} = \frac{3.95+0.21}{12} = \frac{1}{2.88}$$

This shows that the assertion of several technical books: One ton of oil could do same amount of work as 4 tons of coal, does not hold true, under practical working conditions.

The ratio ¼ to 1/5 is, and can only approximately be based on the theoretical comparison of the thermal efficiency of Diesel-motors and steam plants.

Eighteen thousand b. t. u.'s is the average calorific value of good fuel oil, and with a thermal efficiency of 42% useful work is then expressed in 18,000×0.42 b. t. u.'s, while the rest is lost.

The energi-consumption in a steam plant figuring 1.35 lbs. of coal per h. p. hour, calorific value at 13,500 b. t. u.'s and thermal efficiency to 14%, we have following equation determining amount of coal necessary for same amount of work:

$$18{,}000 \times 0.42 = K \times 13{,}500 \times 0.14$$
$$K = 4$$

Against 1:2.88 in practical experience

How much the running expenses are affected if lubricating oil consumption, depreciation and wages are also considered, is given in table No. 4. "Christian X," a motorship built by Burmeister & Wain, Copenhagen, Denmark, equipped with "Uchermark" (superheated steam) has made several 2 months' trips alike, with about 27½ days at sea, and 28 days in harbor and it is upon these vessels that the comparison is based. Speed of both vessels was 11.4 knots; power the same—2,500 h. p.

Some people have had the notion that about 50% of the wages of the engine room personnel could be saved, but this does not conform with practical experience, but is around 75% of a corresponding steamship.

Of special interest is the lubricating oil consumption. The steam engine requires an average of 88/100,000 to 11/100,000 lbs. per h. p. hour, the Diesel-motor requires 5-7 times this amount, as can be seen from table No. 5, which gives a comparison between different motorships and the S. S. "Uchermark."

From the figures in table No. 4 the running expenses per ton of cargo, is ascertainable. By careful comparison of the four main factors, namely: fuel, oil, wages, lubricating oil and depreciation, we see that the superiority of the

TABLE No. 4.

	Motor-ship	Steam-ship
(1) FUEL-OIL—		
Motor-ship:		
Voyage 27.5x11.9 tons..328 tons		
Manouvering .... 20 tons		
In harbor .... 30 tons		
Auxiliary boiler ...... 26 tons		
404 tons at $6.30	$2,545	
Steam-ship:		
Coal, 1,250 tons at $		$4,700
(2) WAGES—		
Motor-ship	900	
Steam-ship		1,200
(3) LUBRICATING-OIL—		
Motor-ship	430	
Steam-ship		65
(4) DEPRECIATION—		
Motorship, 10% for ship plus 12% for motor	5,900	
Steam-ship, 10% for ship and engine		4,500
	$9,775	$10,465
Running expenses per one ton capacity	.61	.65

motorship is not as great as many writers picture it. Furthermore in this estimate, repairs, maintenance, etc., are not considered, but pioneer motorships have thus far all had their hardships. Disregarding the "childhood maladies" all types of ship motors have had and still have awaiting them, burning of fuel-valves, cracks in cylinders and cylinder heads, break-downs of compressors and cooling water pumps, etc. Furthermore it is to be emphasized that the particular construction member of a motor plant requires more attention than corresponding details in a steam plant.

I can cite cases though where motorships have been in service for 3-4 years without any breakdowns of whatsoever nature, when all of a sudden

and apparently uncalled for the above described troubles began to appear.

It is still cracked cylinder heads and jackets, which keeps owners and designers busy.

Without doubt this can be remedied by effective distribution of cooling water in the cylinder head, avoiding "dead corners," which contribute to formation of air-bubbles, the worst enemy to a cylinder head, as these act insulating, thereby minimizing the effect of the cooling medium; also

TABLE No. 5.

Vessel—	Lubricating oil Consumption per 24 hours, lbs.	I. H. P.	Ratio Lubricating Oil per H. P. Hour
Steam-ship "Uchermark"	60	2,500	1.00
Motor-ship "Christian X"	314	2,500	5.25
Motor-ship "W" (single screw two-cycle Carels-motor)	396	2,200	7.55
Motor-ship "S" (under trial)	316	2,400	5.55

too much metal concentrated around parts subjected direct to the fire, for instance around fuel-exhaust and scavenging valves, also on account of too great an overload.

By but a small excess of the mean pressure, cracks in the cylinder head can appear, due to insufficient heat-transmission, so that parts do not expand uniformly or can follow step with temperature stresses.

Special attention must be given to the cooling water system, as a stopping of this, for a few minutes even, can give severe trouble throughout the plant.

(To Be Continued.)

EXPLORATION SHIPS WITH BOLINDER ENGINES.

In the January issue of Motorship mention was made of Captain Amundsen's new vessel in which he will start for the North Pole in July, 1918. It was incorrectly stated, however, that the power equipment would be Diesel type instead of which, as we have recently learned, a 240 b. h. p. Bolinder will be installed.

Another vessel, also for Arctic exploration purposes, and being constructed for Captain Bartlett, is to be equipped with a 160 b. h. p. Bolinder, her auxiliaries including a 20 b. h. p. of the same make but of the stationary type.

NEW 4,000-TON MOTORSHIP.

The Alaska Pacific Navigation Company of Seattle, which recently launched the M. S. "Oregon," has commenced the construction of a second wooden vessel similar in character but considerably larger, and which will be powered with McIntosh & Seymour Diesel type. The name "Alabama" has been chosen by R. M. Semmes, general manager of the company, in honor of the famous warship of by-gone days, which was commanded by Capt. Raphael Semmes, uncle of the above.

The general dimensions of M. S. "Alabama" will be 270 feet over all, 46 feet beam and 26 feet moulded depth. She will be a 'tween-deck freighter with engineroom, officers' quarters and navigating bridge aft. The poop-deck and housing will be shorter than in the "Oregon" on account of the passenger accommodations having been cut out.

The vessel will have a d. w. c. of 4,000 tons and a capacity of 2,000,000 feet of lumber.

The power equipment will consist of a twin set of Diesel engines, supplied by the McIntosh & Seymour corporation, of 500 potential h. p. each, aggregating about 1,500 i. h. p.

The fuel capacity will be sufficient for a 10,000-mile cruising radius. Her auxiliaries will include a 75 b. h. p. C. O. type Fairbanks-Morse oil engine, driving a 50 k. w. generator, which will furnish current for electric anchor windlass and deck winches, to be supplied by the Pacific Machine Shop of Seattle.

The approximate cost of the Alabama is estimated at $375,000.

Considerable improvement is being made at the company's plant, which includes $15,000 worth of new machinery, under the supervision of Superintendent O. J. Thorsen. The Alaska Pacific Navigation Company will make an effort to have this vessel afloat by Jan. 1, 1918.

AUTOMOBILE ENGINES PROVING HIGHLY SATISFACTORY IN MOTOR BOATS.

Geo. W. Miller Company have developed a large and very interesting business in the sale of automobile engines for boats. The care with which this business has been developed has, in a large measure, broken down the prejudice which was formerly felt by marine engineers for this type of motor.

At Lowell, Wash., one of the motors furnished by this Company, a 60-horsepower Stearns, is operating a large side-wheel ferry across the swift waters of the Snohomish river, conveying live stock, pedestrians, automobiles and all of the usual ferry boat traffic.

At Astoria, Ore., Capt. W. H. Walker is operating a boat 32 ft. long with 9 ft. beam and 4 ft. draft with a 2-cylinder Carter car engine, developing 18 horsepower at 760 revolutions a minute. This boat gives 8 miles an hour when running to and from the fishing banks and will throttle down to two miles an hour when trolling off the banks of the Oregon coast.

Another interesting performance is a boat owned by the Neuss Boat Co., near Leschi Park, Seattle. This boat is a runabout 26 ft. long by 5 ft. 4 in. beam, carrying a 4½x5 in. 4-cylinder automobile engine with an 18 in. propeller and 24 in. pitch. This boat has been running for three years, developing 18 miles an hour with ease, and during the entire three years of operating has not been overhauled or in any way repaired.

The use of these motors is particularly satisfying to boat owners in these times of delayed deliveries and high prices of manufactured articles. The application of the large diameter, low pitch propeller has proven them very satisfactory even for heavy duty service, and the Miller Company reports a rapidly growing volume of motor sales for marine work.

EASTERN SHIPPING MAN CALLED TO COLORS.

Motorship is in receipt of the following communication from Messrs. Reginald A. Brett & Co., steamship brokers of 30 Church St., New York: "We wish to announce that our Mr. Brett has been called on for naval duty, and that the business of Reginald A. Brett & Co. will be in charge of Mr. Paul L. Pinkerton, with offices at the same address."

NEW SHIPS HARDWARE COMPANY.

The Dukehart-Denise Company, Inc., of Baltimore, Md., are arranging to supply ship fittings which will include cleets, hawse pipes, chocks, etc., apart from heavier deck euqipment.

The Dukehard-Denise company may also handle a heavy marine oil engine agency.

Notes on Oil Engine Lubrication

By H. W. LUTES, First Assistant Engineer M. S. "Marie."

WHILE the oil engine is being installed in a large number of vessels, there has been very little practical information written on the operation by persons who have handled them under sea-going conditions.

This article applies to the two-cycle surface ignition ("semi-Diesel"), the type that is being installed in most of the boats.

I will confine myself to the lubricating of the machine, which may sound foolish when such hot battles are waging between "semi-Diesel" and Diesel and two and four-cycle.

Bearing and lubrication trouble, however, has delayed more boats in operation today than any other cause, therefore it is an important subject.

Practically all large oil engines are fitted with force feed oilers either made by the engine builders or purchased from makers of same.

Most of them made by independent manufacturers work on about the same principle. There being two small pumps for each feed, one pump raises the oil to the sight feed and it drops to a well, from the well the other pump forces it to the bearing or cylinder.

These pumps are very small and dirt, dust or lint from waste will soon plug them or the check valves.

It is of utmost importance that all oil put into them be well strained through a strainer of 30 mesh or smaller. The strainer that is in the filler opening is generally too coarse. A filter which holds a quart of oil or more that can be inserted into the filler opening and secured so it will be safe against the roll of the vessel is best. A very fine strainer can be used in this way as the engineer does not have to wait on the straining.

They are simple to make and inexpensive. The strainer should be removable from the filter, as it is much easier to clean.

If the oil is well filtered cleaning of the lubricator will not be necessary oftener than once a year or even longer.

When cleaning is necessary never use waste, but rags.

The size of copper tubing used on most engines is too small; it would be better, in the writer's opinion, if the builders would use a larger size.

The pipes should be blown out when overhauling the engine, but be sure and pump them full again before starting engine.

The springs in the checks are usually made too strong; it is well to cut off a small piece.

Centrifugal ring oilers are used on most engines for crank pin lubrication. They should be cleaned whenever possible as carbon and gum collects in them, closing the oil hole.

Burning out of crank pin bearings has caused a large part of the trouble with oil engines now in operation.

When new bearings are fitted they should be scraped-in very carefully so that all the metal is in contact. Many engineers and oil engine men recommend that the bearing be rather loose. I think they run better if they don't have too much play, such has been my experience.

How can you tell when a crank pin is running hot? is a question that is being asked continually.

Care should be used on the trial runs and whenever a new bearing is fitted to shut her down and notice if they are heating and bear in mind the pins that run the warmest under working conditions. The main bearings should be felt every half hour; if a crank pin bearing is slowly heating the main bearing on each side will sympathize with it and warm up, too. By training the touch in this way crank pin trouble can be eliminated.

No rule can be used for the amount of oil necessary, the engineer must use his own judgment.

An engine which has good combustion so that only a small amount of tarry substance and carbon is formed, will require much less lubricating oil than otherwise.

Notice the condition of the piston when crank is on lower dead center. There should be a film of oil all around. Carefully examine the piston, and especially the surface that is distant from the points where the oil is introduced into the cylinder, as it will have a tendency to be starved here.

Whenever a piston is drawn don't let it turn but pull it out in same vertical line as it assumes under working conditions and examine carefully for dry places. This is a good guide to lubrication.

The oil has a tendency to lubricate in stripes on each side of the point of introduction. On account of this, engines should have more feeds for cylinder lubrication and thereby it would be possible to cut down the amount of oil used.

The ideal force feed oiler is the one that is timed to the engine so that the oil is forced into the cylinder when the oil holes are open and the piston is at the bottom of the stroke. The piston is thus thoroughly lubricated for its whole length and the oil has more chance to distribute.

This type is not in use yet to the writer's knowledge for marine work. (The above excellent suggestion is well worthy of consideration by engine manufacturers.—Editor). The kind of oil to use is another hard problem to solve. I have found from my own experience that no oil can beat a Western or asphalt base oil, a good heavy oil, or if the engine room temperature is fairly high an extra heavy oil will be found more suitable.

OIL-FIRED STEAM-DRIVEN TANKER COSTS HER OWNERS $182,750.

Shipowners in general seem to be very nervous regarding the reliability of Diesel-driven motorships, a number of which are tankers, so it may be well to record the case of the "San Onofre," a steam-driven tanker of 9,717 tons, which was disabled in the North Atlantic, due to the failure of the heating coils, that are provided for keeping the supplies for the fires in a liquid state. A small matter, but it completely put her steam propelling engines out of business. The "San Onofre" was towed into Halifax by the S. S. "Astabula" of the same line, causing the latter to lose 29 days. The Admiralty Division recently awarded the owners of the "Astabula" the sum of $182,750, of which $22,750 went to the captain and crew This sum, if due, to Diesel engine failure would have caused a great shout!

In any event the "San Onofre," and other vessels, would do well to have a Diesel-driven electric lighting and wireless plant on deck, because her wireless was only kept going by burning all the available woodwork in the ship.

MOTORSHIP

A journal devoted exclusively to Commercial Motor Vessels and their operation. Issued on the 25th of each month.

1321 L. C. Smith Building, Seattle, Wash.

MILLER FREEMAN .... Publisher
RUSSELL PALMER .... Manager

Eastern Office, South Ferry Bldg., New York City.
San Francisco Office, 88 First Street,

United States and Mexico, per year $3.00
Canada and Foreign Countries in Postal Union... 3.50
Single Copies .... .25

All changes and new copy for advertisements must be furnished prior to the 5th of each month.

Entered as second-class matter at Seattle, U. S. A.

Notice of discontinuance of advertising must be given before the 1st of the month preceding issuance.

WHY ARE MANY AMERICAN SHIPOWNERS ANTAGONISTIC TO THE DIESEL MARINE ENGINE?

CARGO-CARRYING, Diesel-driven, steel motorship construction is proceeding rapidly in Norway, Holland, Russia, and Denmark, and in those countries the proportion of motorships building actually is greater than that of steamers. Great Britain also is building some more motorships. Yet, in the United States there still seems to be a vague undefineable and almost mysterious element that apparently keeps the important shipowners almost antagonistic to the Diesel-type engine, and, as yet not a single large steel merchant vessel of this class has been ordered. Many of these shipowners appear to exult when minor accidents are today reported of some, or other, motorship built four or five years ago, and then smile amusedly or sceptically when an excellent motorship operation report is submitted to them, or else treat the matter with indifference.

Big European Diesel motorships enter our harbors daily, and, although such vessels are proven to effect economies running into hundreds of thousands of dollars annually per ship, shipowners imagine themselves too busy to spare a few hours to personally inspect such vessels and see for themselves. We say "imagine" because such men will find time to spend a day endeavoring to save several thousand dollars on some ordinary contract, yet will not devote a few hours to investigate what would mean savings of hundreds of thousands of dollars to them. The claims made for motorships alone should be sufficient to warrant proper investigation, and when such claims are supported by absolute proof, the shipowners' strange attitude can only be regarded as sheer stubbornness.

Motorship failures have occurred, and no one will deny—but, that was to be expected in the case of a prime mover that was developed so rapidly. But those failures should not deter shipowners of the United States. Instead they should investigate the real causes of those failures and ensure that the engines ordered by them were free of such causes. But, the Diesel cycle should not be blamed for mere mechanical faults that arose through bad engineering, or through inexperienced designs. Every once in a while disgracefully built and designed steamers are placed in service; but shipowners do not blame the steam engine when they suffer from the unreliable operation of such steamers.

If only shipowners would take sufficient interest to firmly grasp, or implant in their minds, what a tremendous advance the Diesel-engine is over the steam-engine they would do far more than they have done to assist in its development, and ensure of its success.

There can be no gainsaying but that the Diesel engine will ultimately entirely displace steam machinery for merchant ships, and the period of time that this takes is entirely and absolutely in the hands of shipowners themselves, and does not—as many think—rest with the Diesel engine builders. The engine builders have done far more than their share, and now further progress depends upon the co-operation of the shipowners. It is shipowners that will make the greatest gain by the accrued economies and not the engine-builders; for, most of the marine Diesel builders also build steam machinery, and at this stage it is less trouble to them to sell and build steam plants.

Furthermore, when the time comes for Diesel engines to replace steam—and that time is not far distant, except in high power—it means that many boiler shops will be closed down. This fact should impress itself upon shipowners because at present they are paying for the construction, maintenance and operation of tens of thousands of boilers. Hence, if there are no boilers their pockets must benefit to an enormous sum annually, apart from the tremendous fuel saving, cargo gains and absence of firemen.

European shipowners have shown willingness to "risk" large sums of money in Diesel motorships in the days when the "risk" was a hundred per cent greater than it is now.

Yet, it is almost beyond belief that many of our largest domestic shipowners—who now are at the wealthiest period of their existence—are unwilling to venture to the extent of ordering large motorships, although the advantages are enormous, and although they have before them records of Diesel ships that have given more reliable results than steam.

Let such shipowners ponder over the operations of the Diesel-driven German submarines, which in themselves threaten to destroy every steamship afloat. The Diesel-engines of these submarines are working under conditions and circumstances that are ten times as severe as they are aboard the average merchant ship. The submarine Diesel engines are light, high-speed units, that suffer from excessive heat, and from excessive wear, due to small working parts, such as bearings and cranks; they suffer from the absence of crossheads and guides, and are crammed into a very small space where adjustments are difficult.

Yet, even with these great difficulties before them those German submarine Diesel engines perform their work in such an efficient manner as to enable the submarines to cast consternation among shipowners and upon naval authorities. Let shipowners fully comprehend that these submarines could not effectively operate were not their Diesel engines reliable. How much more reliable is a well-designed, well-built, mercantile marine Diesel-type engine, with its large bearing surfaces, slow speed, crossheads and guides, and absence of wear, and low heat temperatures?

It really is time that shipowners of this country took the Diesel engine very seriously, not only on its merits; but on its immediate possibilities. The attitude of "let the other man do the experimenting" is one not worthy of a progressive nation which is endeavoring to become the leading maritime country. In fact, it is a contemptible view to adopt. While such a narrow-minded position is taken by many of our leading shipowners the United States can never do more than "hope" to become the greatest shipowning nation on earth. Other nations regard America as being progressive; but in the shipping business there is an over-cautiousness bordering upon cowardice.

Cannot this all be changed? This change can come about, and will come about, by every important shipowner personally devoting say, one-half day per week thoroughly investigating the operations and economies of Diesel motorships. The time thus spent will repay itself a hundred fold. Look at what little Denmark and little Holland have done! Americans have more money for development than have shipowners of those little countries, yet they have been able to build motorships.

SWEDISH GOVERNMENT LOANS FOR MOTOR-SHIP CONSTRUCTION.

Loans for assisting the building of 22 motorships have been granted by the Government of Sweden to Swedish shipowners, and the following motorships are now under construction.

Owners—	Tonnage per Ship	No. of Ships	Amount Loaned
North Star Steamship Co.	10,000	2	$238,500
Transatlantic Shipowning Co.	9,000	1	139,000
Stockholm Transport & Engine Co.	500	3	139,000
Calcium Shipowning Co.	600	3	104,165
S. S. Patterson Shipowning Co.	....	3	83,500
Erik Olsson Timber & Trading Co.	....	3	69,500
Bäckerod Shipowning Co.	....	3	41,650
P. Kollin	500	1	27,750
Trigga Steamship Co.	....	1	27,750
C. Backlof	....	2	19,500
Total		22	$890.310

Loans also have been granted for the construction of 13 steamers, but it will be seen that the motorships predominate, a lesson which this country should take to heart. These loans are granted, up to half the value of the ship built, at 5 per cent interest, and repayable by installments during eight years.

DIESEL EXPERTS.

Far be it from the policy of Motorship to criticize contemporary publications; but, today we are at war and war is a serious affair, and when a matter concerns the safety of the country we feel at liberty to make a few comments. We notice in the May issue of a yachting contemporary that they have published the portrait of their staff "Engine Expert"; together with a statement to the effect that he is now to be an expert on engines for the Navy, with a rank of Lieutenant j. g.

So far, so good. But, we happened to also notice in the same issue an editorial article by this said "engine expert" entitled "A Vital Power in War," this dealing with the importance of the internal-combustion-engine in war. We cannot refrain from giving a few choice extracts from this article, because, if this "expert's" knowledge is equal to the accuracy of his statements, Heaven help the U. S. Navy!

Here are a few:

"So far as I have been able to learn no semi-Diesel engines, or true Diesels operating on the two-stroke-cycle, have ever been used in submarines, notwithstanding the fact that there are engineers who claim that two-stroke-cycle Diesels and both two and four-stroke-cycle semi-Diesels could be used advantageously."

"Diesel engines, such as are used for propelling submarines, are extremely susceptible to "scored" cylinders, which render them ineffective."

Seeing that he evidently poses as an "engine expert," his statements are apt to be taken as gospel by the ignorant reader, so he certainly should use a little more care before publishing assertions which are foolish and misleading. In the past a tremendous amount of harm was done to the marine Diesel engine by the publication of "trash" by "experts." Sections of a subject over which a journalist is not absolutely certain, should be left out, on the basis of "when in doubt, leave out."

This "expert" raised the foregoing points, which we will answer as follows:

(1) The Swedish submarine "Hajen" is driven by an Avance hot-bulb (semi-Diesel) 200 b. h. p. oil engine of the two-cycle type.

(2) Over 50 per cent of submarines built up to today all over the world have been fitted with **two-cycle-type** Diesel engines, especially in U. S. A. submarines, and it is only recently that America has turned to the four-cycle design.

(3) His statement that submarine-type Diesel engines are subject to "scored cylinders which render them ineffective," is a most damning one, and it would be well to inquire upon what, or whose, authority such a rash statement is made.

In ordinary times we would refrain from commenting upon the above, but this "expert" is now one of the men upon whom the safety of the country depends.

SET A THIEF TO CATCH A THIEF.

Today the greatest menace to the world's shipping is the German submarine. Every German submarine is driven by Diesel engines, and the present terrible undersea warfare would not be possible were it not for the Diesel-type engine. There is an old saying "Set a thief to catch a thief," under which logical ruling, all large submarine chasers should be Diesel-driven. Why this reasoning is as sound in practice as in theory will fully be understood after reading the article in this issue entitled AN IDEAL SUBMARINE CHASER. Navy Department please take note. Also, another solution to the "breaking-the-submarine-blockade" problem is the use of Diesel-driven cargo ships, because of the low visibility of the motorship, due to absence of betraying smoke.

OBITUARY.

It is with regret we notice the death of George H. Hitchings, who died May 26th, at the Seattle General Hospital.

Mr. Hitchings, who was the manager of the Pacific American Fishing Company's shipyard at Bellingham, Wash., was a naval architect of considerable ability and recognized by all as a leading authority on the Pacific Coast in wooden ship construction.

Among the most recent vessels built from his designs were the motorship "Sierra" and the steamers "Redwood" and "Firwood."

Design of the New Acme Marine Gas Engine

WHEN it was recently announced that Richard Froboese, who has been intimately associated with the marine internal combustion engine business of the Pacific Coast in the capacity of a designer for some years past, had undertaken the design of a new heavy duty engine great interest was aroused in the trade generally. Mr. Froboese's designs are now completed and are offered here in their general particulars for the first time.

Standardization and simplification have been the principal objects in view by the designer. The success which has attended his efforts will be readily ascertainable from an examination of the general plans reproduced herewith and the specifications which follow.

It is the intention of the Acme Engine Co. to manufacture the new engine with a range of from 7 h. p. in one cylinder to 125 h. p. in six cylinders, with three different cylinder sizes.

In planning the design and construction of the Acme engine the builders have put forward their best thought and very many years experience in the heavy duty marine engine business, to introduce an engine that will contain all the features that modern practice have proven to be most desirable and practical.

The standardization of engine sizes, in order to have interchangeability of parts is one of the important objects.

Following are the general specifications of the Acme engine:

Design.—The Acme engine is of the "overhead" valve construction. This design being selected because of fuel economy, it being claimed by the manufacturers that for a given bore and stroke the overhead valve type four cycle internal combustion engine produces the greatest amount of power for the amount of gas consumed. The igniter is also placed in the cylinder head directly above the piston thus bringing the distance from the point of ignition to the various points in the combustion chamber much closer than either the "T" head or the "L" head type of engine; in this way the charge of gas is most rapidly burned and there is no lost power on account of side pockets in the combustion space.

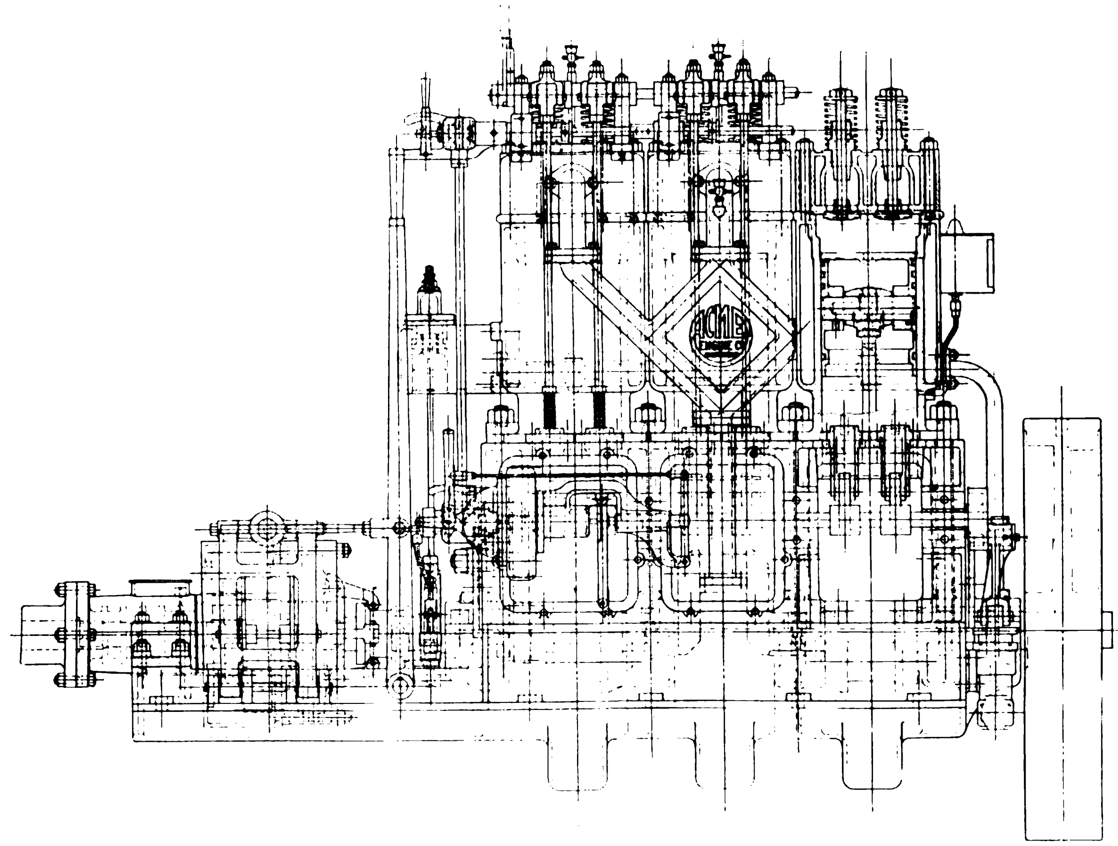
Bed Plate or Base.—The bed plate casting is very substantial and cast in one piece including the extension for reverse gear clutch bearing and thrust. There are separate crank pits for each crank and oil-tight cellars under each bearing, which are of the ring-oiling type. The crankshaft journal bearings are of plastic bronze, easily removed and interchangeable. They are also fitted with shims for taking up wear. When the frame is fitted to the bed plate it is tightly enclosed to prevent burnt gases and oil escaping into the engine room.

Frame.—The frame is cast in one piece, planed to fit the bed plate and bored to jigs to properly hold the cylinders in alignment. The sides of the frame are fitted with large oil-tight doors on both sides to give easy access to the crankshaft bearings, etc. This frame carries the cam shaft on the inlet side of engine which is bedded on bearings on both sides of the frame between each cylinder, and is easily removed without disturbing any other mechanism. The doors on the exhaust side of the frame are made large enough to permit the removal of the pistons and connecting rods through the crank frame without interfering with the cam shaft or other working parts.

Crankshaft.—Are forged from solid steel billets of high tensile strength, each billet is tested by Lloyd's agent according to rules of Lloyd's Register for marine shafting. The crankshaft bearing surfaces are exceptionally large.

Connecting Rods.—The connecting rods are made of the same material as the crankshafts and are subjected to the same inspection. At the upper end they are provided with hard phosphor bronze wrist pin boxes, and at the lower end they are fitted with plastic bronze crank pin boxes. The boxes are in halves and fitted with thin metal shims so that wear if any may be taken up in a few minutes. The boxes are fastened to the rods with blue steel bolts with two nuts and cotter pins on each bolt.

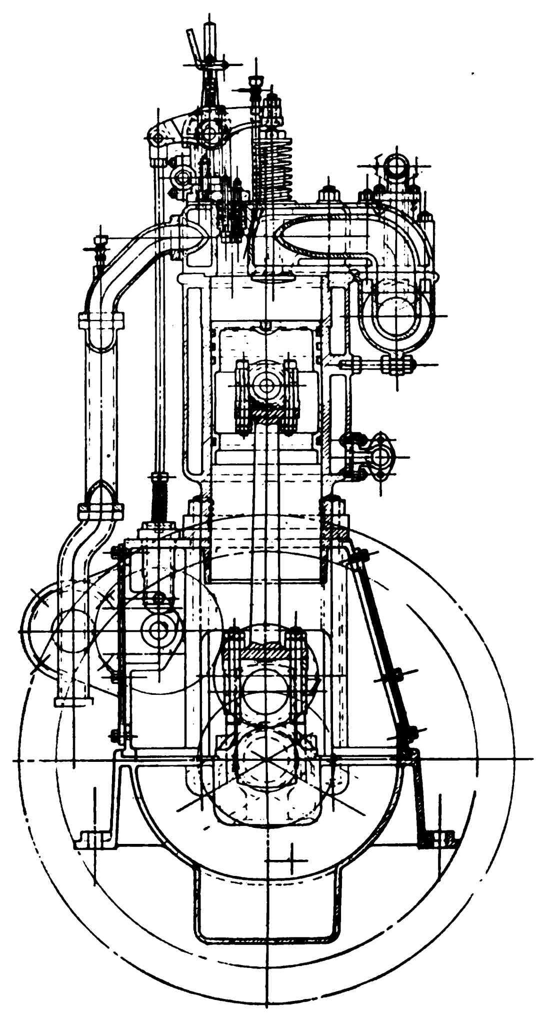
Valve Mechanism.—The cam shaft is driven by spur gears housed in the frame at after end. The rims of the gears are of solid steel forgings accurately machined, shrunk on to the cast iron center and the teeth cut into the solid steel. The cams are made of machine steel milled and hardened. The exhaust cams are interchangeable as also are the inlet cams. Both are fastened to the cam shaft with gib head keys. The valve lifters are provided with large interchangeable rollers which are made of machine steel and hardened.



GENERAL ARRANGEMENT PLAN OF ACME ENGINE

On all six cylinder engines the cam shaft is made in two pieces and driven by spur gears housed in order to avoid excessive strain on the gears or shafts. The cams, cam shaft, valve lifters and cam shaft operating gears, are run constantly in a bath of oil.

Cylinders.—Special care is exercised in the construction of the cylinders, which are made of the finest quality of close grained gray iron, water-jacketed throughout, accurately centered in frame, bored and reamed, assuring the perfection of accuracy so essential to the most important part of the engine. The cylinders are cast separately, also the heads, which are held in place by studs. The circulating water is passed through outside by-passes, from cylinders to heads. These by-passes are of liberal size to insure a free and easy circulation through the cylinder heads.



SECTIONAL PLAN THROUGH FORE END

Valves.—Inlet and exhaust valves are mechanically operated and interchangeable. The valves are extra large in area; have very large seats and seldom require regrinding. Perfect water circulation around valve space in cylinder heads prevents overheating. The valve guides are a separate casting fitted into the cylinder head and are easily removable.

Slow Down Mechanism.—Owing to the requirements of the purse seine fisherman in the Northwest, and the Tuna fisherman in Southern California, all Acme engines will be equipped with a special slow down attachment permitting the operator to slow the engine down when trolling or purse seining so that the boat will be propelled at a very slow speed.

Compression Release.—A single lever is furnished to relieve the compression for all cylinders, to enable the operator to start his engine easily.

Exhaust Manifold.—The exhaust manifold on all multi-cylinder Acme engines is a separate casting held in place by support studs in the cylinder, so arranged that it will not be necessary to disturb the exhaust line or piping to remove one or all of the cylinder heads.

Rocker Arms.—By means of a special spring arrangement rocker arms operate the valves noiselessly.

Cylinder Heads.—Are all cast separate and thoroughly water jacketed and have a projection into the cylinder under which a copper gasket is inserted in such a manner as to render the blowing out under pressure impossible, and it is not necessary to replace the old gaskets with new ones when the heads are removed for inspection.

Piston and Piston Rings.—The pistons are made from best close-grained gray iron, free from flaws and have splash oil rings. They can be removed from above or below, which ever preferred; below, by removing proper frame doors, and above by removing the heads only. The piston rings are of the regular snap ring type, made eccentric so as to give an even pressure on the cylinder walls, thus insuring even wear throughout. The piston wrist pins are made of machine steel carefully machined, hardened and ground.

Carburetors.—All Acme engines are equipped with Schebler carburetors, which are of the float-feed type. The suction end of these carburetors are connected by pipe leading to hot air sleeves on the exhaust pipe, for vaporization of the fuel.

Governor.—The engine is fitted with a substantial sensitive governor, which controls the

fuel as well as the air valve thereby getting a perfect gas mixture at all times. The governor is driven by spur gears direct from the cam gear, without belts or friction and is fitted with speed attachment whereby the speed of the engine may be changed as desired, at any time while the engine is in motion. The governor balls and operating mechanism are also enclosed, being located in the after frame door, and thereby receives the benefit of the oil splash lubrication.

Ignitors.—The ignitors are of the "make and break" type, very durable and simple. The ignitors of all Acme engines are one size only, therefore the one ignitor will fit from the smallest to the largest engine to be built. They are easily detached from the cylinder head, in which they are located, by loosening two nuts. The time of ignition can be advanced or retarded at will, and thereby the speed changed while the engine is running. The ignitors can be removed without disturbing any other part of the engine. Any purchaser preferring jump spark ignition instead of make and break, can have the engine equipped if he will so specify, at time of placing the order. No extra charge is to be made.

Magneto.—All Acme engines will be equipped with high grade magneto, gear driven and timed to the engine.

Water Circulating Pump.—The water circulating pumps are either of the plunger or centrifugal pump type. Plunger pumps are attached to all marine engines. They are of ample capacity under all conditions, and are equipped with special large check valves, and are driven at half speed by the cam shaft. An additional centrifugal pump is used on all 50 h. p. and larger size marine engines. They are driven by friction from the flywheel. On all engines where centrifugal pumps are used for water circulation, the plunger pump which is attached to each engine can be used as a bilge pump, or auxiliary engine pump, as the discharge is connected through three-way cock to main water inlet manifold to cylinders.

Reverse Gear Clutch.—Reverse gears are of the spur gear type. The gears are made of forged steel, accurately machined and cut; the pinions are all bushed with bronze bushings; and the gears and pinions are housed in an oil-tight drum which is filled with lubricating compound. The shaft carrying this reverse gear is on all one, two and three cylinder engines part of the crankshaft, on all four and six cylinder engines it is a separate shaft, forged from the best hammered steel, with forged coupling, and by being bolted to the crankshaft, can be easily disconnected which permits an easy removal of the reverse gear from the engine. The reverse gear friction is of the multiple-disc type easy of adjustment, and liberal dimensions. Inspection of the multiple-disc clutch is easily accomplished by removing the nuts which hold the reverse gear extension piece, which in fact is only a cover over the friction plates.

Thrust Bearing.—The thrust bearing is securely bolted to the engine base. This bearing is very long and lined with the best grade of genuine babbitt. The thrust is taken up by thrust collars turned on the solid center gear extension.

Air Pump.—All Acme engines are equipped with an air pump for whistle outfit. The pump to be operated by an eccentric on crankshaft between the after main bearing and reverse clutch.

Lubrication.—The cylinder, pistons, piston brasses forward main bearing, thrust bearing and other parts are lubricated by means of a mechanical force feed oiler. This oiler is positively driven instead of belt driven.

The main journal bearings which are fitted with plastic bronze boxes, have large oil cellars directly under them and are fitted with ring oilers. The base of the engine is arranged as an oil receptacle, and the well known splash system of lubrication is used for all the lower bearings, cams, etc.

The designer claims this method is most satisfactory, as all the moving parts are constantly running in a bath of oil. Furthermore the operating cost for lubricating oil is said to be much less because not near the quantity of oil is required, provided a good grade of oil is used, as compared with any other system of lubrication.

Standardization.—As all parts of Acme engines are to be made to jigs and gauges, wherever possible, there will be no difficulty to furnish parts that will be interchangeable. It is the intention to have jigs for all parts of the engine that it is possible to jig, so that the customer ordering a repair part will have no trouble in placing it on his engine upon arrival. Owing to the fact that there will be but four bores and strokes of engines, and seventeen different power units made from these four bores and strokes, it enables the builder to standardize construction much better than if there were twelve to sixteen bores and strokes for a like number of power units.

ON CROSSHEADS.

May 24, 1917.

Editor of "Motorship."

Dear Sir—The excellent discussion in your May issue concerning the use of crossheads in marine engines can be usefully summed up in the statement: Since good design requires that wherever possible distinct functions should be performed by separate parts particularly designed for them, it is desirable that a crosshead be provided to take care of the connecting-rod side-thrust and a rod and piston to receive the gas pressure thrust and to make the moving gas-tight joint. The amalgamation of these various functions in a single member, as it occurs in the trunk-piston engine, is what produces the liabilities enumerated in the article.

Naturally any such general considerations as these must not be pushed too far. Small cylinder dimensions do not call for crossheads for self-evident reasons. Crossheads should be dispensed with even in larger sizes of engines if they are intended for high-speed vessels as opposed to cargo and work boats. The power required to drive a vessel increases out of all proportion to the speed at which it is driven so that if crossheads were used in engines for fast boats, machinery weights would in general be so great as to cause difficulties. In a slow-speed vessel the weight of the power plant is a relatively smaller consideration, therefore the weight added by the use of crossheads is also smaller and is a price well worth paying for the safeguards which they furnish.

Very truly yours,
JULIUS KUTTNER,
567 West 113 St.,
New York City.

CRAIG DIESEL FOR SUBMARINE.

The new submarine F.-3 at the Mare Island Navy Yard is to be equipped with twin 250 h. p. Craig Diesel engines. The engines were ordered through the Union Gas Engine Co. and are on the way from the East.

The Skandia Pacific Oil Engine Company

PLANT OF SKANDIA PACIFIC OIL ENGINE COMPANY AT OAKLAND, CAL.

THE extent to which Oakland, California, has become a center for the manufacture of marine internal combustion engines is perhaps not recognized generally throughout the United States, but the fact is that there are grouped at that point more plants of this character than are to be found in any other single locality in the country. Oakland early became a center to the manufacture of marine gas engines. Most of the power plants of this type used on the western coast being built there. It was therefore only natural that Oakland should become the cradle of the Pacific oil engine industry. Among the newer concerns to locate on Oakland Estuary is one which specializes in marine oil engines—the Skandia Pacific Oil Engine company.

This company grew out of the J. H. Hansen company, which was formed in the latter part of 1915 by J. H. Hansen and Jafet Lindberg.

The former company had, up until this time, been agents on the Pacific Coast for the Skandia Oil Engine, which was manufactured for 18 years by the Lysekils Mek. Verkstads, Lysekil, Sweden, and which had enjoyed many and varied uses, inasmuch as marine and stationary engines of this make had been installed in nearly every part of the world.

In Norway and Sweden alone over 5000 installations of these engines have been made in fishing boats. This agency was successful in placing many orders for marine and stationary engines with the factory in Sweden, but the amount of business there coupled with the advance in prices of the engines due to higher prices of material and labor, made it practically impossible to place an order and expect any kind of reasonable delivery.

In the fall of 1916, due to the greatly increased demand for the Skandia engine on the Pacific Coast, it was decided to form a corporation and to secure a factory site suitable for the manufacture of these engines. The present company was formed, and obtained the exclusive manufacturing and sales rights for Skandia engines in America. Drawings, patterns and Swedish engineers were brought to the United States to superintend the construction of the engines and to assist in installations.

The new company began to negotiate for a factory site. The plant of the Gorham Engineering company was acquired and plans were at once laid for the immediate construction of the engines on a large scale. The factory was taken over on the 17th of November, 1916, and that day raw material in the shape of connecting rods was delivered at the plant. On the following day more material arrived and the manufacture of Skandia engines was started.

The factory formerly made marine gas engines and had a large assortment of tools with which oil engines up to 100 h. p. could be made. For the manufacture of engines of higher horsepower it was necessary that much of the larger machine work be sub-let to shops on the outside. A very close and careful inspection has been made on all this sub-let work and to this is due the success of their installations. This sub-letting will have to be done until deliveries are made of the larger tools, now ordered.

The plant is situated at 2893 Glascock street, and has a water frontage on tidal canal, connecting with the harbor at Oakland. Spur tracks, connecting the factory with the Oakland Belt line, which makes connections with the Southern Pacific, Western Pacific and Santa Fe railroads make for facility in the receiving of raw material and in the shipment of set-up machinery.

An electric crane from the main floor of the factory runs over the spur track facilitating loading or unloading. A crane handles all pieces from the docks.

In the main building are located the offices of accountants, bookkeepers, purchasing agent and manager. Here, too, is a light drafting room.

The main building is divided into two parts—the machine shop, with a large and fine variety of tools, lathes, bores, shapers, etc., above which are placed air jib cranes; this building also contains a testing room with solid concrete floor in which all apparatus for testing is installed.

Through these sections of the building two electric cranes of 10 tons capacity are used in

SKANDIA PLANT AT OAKLAND VIEWED FROM WATER

assembling the engines. Above these large tools are placed air jib tools.

Directly opposite the office is the store room for raw material and finished parts, under the supervision of a storekeeper and his assistants. In this building is located a heat-treating plant furnished with electric and oil furnaces for the case hardening of pins and other parts. A brass factory is situated between the two main buildings. Here all the brass and bronze castings are made. A large pattern shop furnishes all the pattern work required. A compressed air plant furnishes compressed air to all parts of the factory.

Two large lathes 46" and 60" are installed and are driven by 20 and 25 h. p. motors respectively. Two more of the same sizes are expected daily. Numerous other new tools are installed. Among these are an automatic stud machine, for making studs up to 2", a Barrett cylinder mill, a vertical boring mill and a sand blast, which is operated by compressed air blown upon castings to remove all unnecessary parts.

The plant can turn out six 240 h. p. engines in 30 days along with smaller engines. At present engines from 5 to 350 h. p. are manufactured by this company but, with the new machinery, which is constantly arriving, engines up to 585 h. p. will be manufactured in the near future.

The Skandia is a two-cycle, surface ignition, ("hot ball") engine which burns heavy crude residue fuel oil, and is built in powers ranging from 5 to 500 h. p. for stationary and marine purposes. The marine engines from 140 h. p. up are directly reversible being started and reversed on compressed air turned into the cylinders. This eliminates all gears, clutches, etc., which the makers consider impractical in an engine of this size.

The air for starting and reversing is furnished by an air compressor which is mounted on the foreward end of the bed plate and which furnishes air to the storage tanks.

The engines are built on a one piece bed-plate holding all the main bearings for the crankshaft. The thrust bearing is also fastened to the bed bed-plate. Bolted on this bed-plate are the crank houses which support the cylinders and form the main part of the engine.

The cylinders which are the most important and expensive parts of the machine are made of special close-grained iron, and perfect machining is done by most modern tools. The piston, like the cylinder, is manufactured with the greatest care, and of the same material.

Owing to careful calculated dimensions and special cooling by air, and arrangements for reinforcements, the heat and great pressure to which the pistons are submitted does not in anyway affect the working of the piston, nor does it become distorted or warped.

The piston pin is of steel, and after being turned, is case hardened and ground true on a special grinding machine. The connecting rod is of steel, and in its upper end holds the bronze piston pin shells which are split in two halves. At the lower end is the crank pin bearing, which is also split in halves, the bronze shell being lined with the best white metal.

AMERICAN BUILT SKANDIA ENGINES READY FOR SHIPMENT

The cylinder cover is an important part which contains the combustion chamber where the necessary pressure for working the pistons is produced.

The principal feature of the Skandia engine is this water-cooled combustion chamber, which has added to it on the side, a small hot ball which aids in the combustion of the fuel. The cooling in the combustion chamber is as effective as in the cylinder, and this construction not only insures a perfect working but also increases the efficiency of the engines to a great extent.

It has been found that the engine can retain the heat, without load, at longer periods than would otherwise be the case, which is very essential in the small engines used in fishing boats, etc.

All engines are equipped with a governor which works with remarkable precision. The regulation of the speed is affected by a lever. This governor is in direct connection with the fuel pump, and by means of an adjusting screw, combined with the governor the fuel feed may be regulated instantaneously while the engine is running, and after the stroke of the pump has been adjusted to suit the load, the engine will run continuously at the same r. p. m. At normal load the exhaust gases are smokeless.

Lubrication of the engine is accomplished by the use of a mechanical pressure oiler with side feeds which furnishes lubricating oil to all parts of the engine.

The fuel pumps have bronze tops and checks, and the plunger is of steel, case-hardened and ground.

In the design of the 350 h. p. engines, deviations have been made from the usual Skandia practice of compressing the scavenging air in the crankcase, by using a special air receiver.

In engines of this size it has been found to be of great advantage to have an open-base engine in which the crank pin bearing may be installed at any time without stopping the engine. This engine is built with an open crank case, and the scavenging air is obtained from air cylinders placed on side of engine at an angle of 30 degrees from center line of main cylinder.

This scavenging air pump is operated by a connecting rod attached to the lower end of the main connecting rod. The scavenging pump discharges the air into the receiver, or connecting pipes, which are located between each pump, so that in a four cylinder engine the pump from the number 2 cylinder supplies the scavenging air for the number 1 cylinder and vice versa. The 3rd and 4th cylinders operate in the same way.

All engines are equipped with torches for the initial heating of the hot balls. During the testing it was found that these engines operate with entire satisfaction on either Calol or Diesel of the Standard Oil company and the Union Oil company, each oil having a gravity of 24 degrees Baume, and weighing about 7½ pounds to the gallon.

G. A. Dimond is foreman of the factory. He has had wide experience all over the United States. He was lately connected with the J. T. Heffernan Co., Seattle, and before that with Frazer and Chalmers, Chicago.

The tool making is in charge of Geo Bartholmes. Mr. Bartholmes was formerly with Brown and Sharpe. A. Johannesen, after 16 years with the Skandia company in Sweden, has accepted a position with this factory and has charge of all the testing.

O. Sterner is foreman on the erecting floor. He was connected with the Atlas, Standard, Hercules and Gorham plants for 11 years.

Albert Little is foreman in the Automatic Machine Department. He was demonstrator for Jones and Lockmann for years.

The officers of the company are J. H. Hansen, president and general manager; Jafet Lindeburg, vice-president; G. W. Campbell, secretary and treasurer; W. J. Gray, Jr., is assistant to manager.

Skandia engines are represented by the Skandia Engineering company Grand Trunk Dock, Seattle, agents for the Pacific Northwest.

H. S. Johannsen, of 50 Church Street, New York City, is the Eastern agent for Skandia engines.

The Skandia engine manufacturers at Oakland, California, are busy on engine orders for ships building in the Northwest, working three shifts of mechanics in order to insure early deliveries on their orders.

The first engines built in the Pacific Coast factory have been installed in schooner "Margaret" now on the Columbia river.

Another set is being installed in schooner "W. F. Burroughs" building at Portland for Libby, McNeill & Libby. The "W. F. Burroughs" will leave Portland for Seattle the fore part of June where she will load cannery supplies and a full passenger list of employees for one of their canneries in Behring sea. During the winter this schooner will be used in the pineapple trade between the Hawaiian Islands and Seattle.

A third set of these engines is being installed in schooner "Mary" now nearing completion at Astoria, Oregon, which will load lumber here for the west coast of South America.

Two other sets are now on the test blocks at the factory which will be installed in ships building at Grays Harbor.

Eight engines are being built for the Puget Sound Bridge and Dredging company at Seattle, one set having just been shipped.

The five masted schooner "H. C. Hansen" launched May 19th at the Seaborn yards at Tacoma, will also be fitted with Skandia engines, as well as two large schooners now under construction at the National Shipbuilding company yards at Seattle.

The schooner "Astoria" now on her maiden voyage to Port Pirie, Australia, made a very fair trip from Portland to Honolulu, from where the last reports were received. The run was made in exactly twenty days, every knot of which was motored, no sail being used on account of heavy head winds prevailing all this distance. The fuel consumption was considerably below that guaranteed, and the engines worked very satisfactorily. This speaks very well for the two 240 b. h. p. engines installed considering that these vessels are very full lined, and being of the following dimensions: 250 ft. over all in length, 43 ft. beam, and 21 ft. moulded depth, and carry 1,500,500 ft. of lumber, 1000 barrels fuel oil, besides fresh water and stores for a return voyage.

All of the above sales were made through the office of the Skandia Engineering company, naval architects and marine engineers, and who are the Northwestern agents for these engines, with office and show rooms at 101 Grand Trunk Dock.

SUCCESSFUL OPERATION OF TWO MATSON MOTORSHIPS.

The motorship "Annie Johnson" and the motor schooner "R. P. Rithet," of the Matson Navigation fleet of freighters, have had oil engines installed for over a year and in general freighting between San Francisco and Honolulu they have demonstrated in a signal manner the merits of heavy internal combustion oil engines. Each vessel is equipped with a twin set of 160 b. h. p. Bolinder oil engines and with two small Metz & Wiess engines for the air compressors and dynamos. The "Annie Johnson" is 212 feet over all with a tonnage capacity of 847 net. The "R. P. Rithet" is 205 feet over all with a net tonnage of 900. Both are old vessels of British build.

My Experience With Ocean-Going Diesel Motorships

By J. E. Cole, Late Chief Engineer of the M. S. "*Sebastian;*" M. S. "*Abelia,*" *Etc.*

(Conclusion of Article Continued from May Issue of Motorship)

J. E. COLE

THIS arrangement of the flats on the crankshaft journals almost amounts to forced lubrication, and there is not any doubt about the lubricant getting to its proper place; at the under side of the shaft. If the lubricating-oil supply is regular, the bearings run very well with this system. Some mechanical means of regulating the supply of oil is preferable, so that the drip is constant. With the ordinary drip arrangement, namely, the type that is controlled by an adjusting screw, the drip is rather apt to gradually take off and might cause trouble unless carefully watched. Especially so, if there is much variation in the temperature of the engine-room. I have often seen drip arrangements set to the required amount of oil, and within four hours it has been necessary for readjustment, due to a change of wind. Should the temperature of the engine-room have dropped, the oil will have practically stopped, or it may have been the reverse, and the temperature of the engine-room increased, causing the oil to flow more freely, and put the consumption of oil up a few gallons for the day. This temperature effect on the oil is most noticeable on the parts requiring a slow feed, such as cylinder and compressor force-pumps and the small gears on the motors.

With the Diesel engine it does not pay to curtail the supply of oil to the principal running parts, such as the crossheads, crank pins and main bearings. The Diesel engine lubrication can be cut down to just the safe margin, the same way as it is done on the steam engine. But it requires too much watching, and a slight variation on the load will soon cause the use of more oil, than would otherwise have been required, had the supply been more liberal in the first instance. With the main bearings, especially with the two-cycle type engine, the lubrication should be on a very liberal scale. It has been my experience that if one bearing got hot, the others would follow, and it is better to be on the safe side.

Where the engines are cased-in, there is no reason for curtailing oil, as it is not lost, providing the casings are fairly tight. Where the oil is not collected again it is better to let the oil run than the metal in the bearings. But, it is an extravagant way to run a machine without saving the oil. Another point about the main bearings, they should be designed for taking-out without having to lift the shaft. Bearings on motors heat up very rapidly, and if they get hot, drag very badly, as there is not the relief on them as in a steam job. Once a bearing has been hot it is better to get it out, or the other bearing will give trouble also. Owing to the great pressure on the bearings (630 lbs. per sq. inch with the Sebastian's motors), good lubrication and plenty of it is essential for safe running of the engine. If the engines are of the open type (that is, not cased in) the bearings should be protected so that no grit can get into them, or any water which may fall from the cooling system. For as mentioned before, water is one of the most undesirable items on a motor when it gets where it is not required.

On the Diesel engine the principal bearings will always run with a certain amount of heat. With the two-cycle type, this is more pronounced, and until the engineer gets used to this heat, it makes one feel a bit doubtful of the job. The surface of the journal may feel uncomfortably warm to the hand, and will feel almost dry as it turns away from the bearing. By applying more oil, the shaft will still have the dryness as it leaves the bearing, and the extra oil just flows out at the ends of the bearing into the crank pits. If the engines are closed in, the bearings can be flooded with oil and this acts as a cooling system.

With the four-cycle engine there is not so much running heat in the shaft, and it does not run with the dryness compared with the two-cycle engine.

The closed-in engine does not appeal to the marine engineer. He is used to the open type of engine, in which it is possible to see the principal parts of the machine, and to feel round at regular intervals to make sure there is no increase of temperature in the bearings when the engine is in motion, and therefore knows exactly how the engine is running. The lubricating-oil is cut down for the sake of economy to just the safe running margin. For, on the usual marine steam-engine there is no arrangement made for collecting the lubricating-oil after use. As the lubricating-oil is cut down to just the safe margin, it therefore is necessary to feel round the principal bearings at regular intervals. But, hot bearings are not uncommon with the open type of steam engine.

The same feeling applies to the engineer when coming to a Diesel engine. He wants to see and feel round the engine as it is in motion, the same as in a steam job. I felt the same way myself on going away with a closed-in engine. Not being able to see the engine makes one feel as though it is a matter of luck if everything is going on all right inside the casings. Having been to sea with two open-type Diesel engines I have altered my view completely in favor of the engine being closed in altogether. The contrast between the open and closed-in type of engine from my point of view are as follows:

(A) The open type of engine the engineer has the satisfaction of always knowing the temperatures of the principal running parts.

(B) Running parts require more attention, as the lubrication has to be curtailed to prevent the oil being thrown outside the engine, and the drips of oil are liable to stop.

(C) Great loss of lubricating-oil, by splashing out.

(D) Foreign matter liable to get into crank pits and mix with the lubricating oil.

(E) Engineer on watch saturated with oil, (making life unpleasant). A very dirty engine platform.

(F) With a closed-in engine the engineer has the satisfaction of knowing there is no fear of overheating of principal running parts as the engine is practically running in oil.

(G) No splashing out of oil, therefore no loss of lubricating-oil.

(H) Foreign matter cannot get into crank pits.

(I) Cleaner engine-room.

(J) Engineer on watch does not get soaked in oil.

(K) Engineer on watch knows that every part of the machine inside the casing is getting plenty of lubricating-oil by the flow of oil through the various pipes which are supplied from outside the casings.

(L) Requires less attention as the oil goes through in steady streams and the supply is not so liable to stop as with the drip of oil which is necessary with the open job.

With the closed-in engine, however, there is one very necessary point to be observed before starting on a voyage. The engineer should make a personal inspection inside the casings to see that all oil pipes are properly led, for it may have happened that during the overhauling some of the pipes may have been moved out of position. Once the engineer has satisfied himself that all the pipes are in position he can set his mind at rest about any fear of overheating of bearings. [Later engines built by the company that constructed those in the "Sebastian" are inclosed by oil-tight plates and have forced lubrication.—Editor.]

If engine builders would always secure their lubricating pipe inside the casings in a permanent position, so that it would not be necessary to take them down when overhauling, it would be a great help to the engineer. Some of the pipes are often enough bent to all sorts of shapes to get clearance inside the casings, and require quite a lot of time to get them readjusted again, if they have got out of position. Lubricating-oil pipes should always be of ample bore. If the bore of the pipes are small, and the oil gets a bit thick, which it sometimes does after being in circulation for some time, the oil will not flow freely enough through the pipes. With the larger bore of pipe they are much easier cleaned by blowing through with compressed-air.

With the different types of compressors which it has been my lot to sail with, there have not been any serious troubles. If the cooling arrangements are ample and the lubrication is watched carefully there is not much bother with sticky valves or carbon deposit in the ports through the valve seats. The amount of lubrication required can only be obtained by close observation for a few days, and once this is obtained, clean running is the result.

In the case of some designs the valves wear rather heavy and give trouble by breaking the springs, and I have known the same compressors to run quite as efficiently with the broken springs, and with the stems broken off the valves as long as the engine has been kept running. If the engine has been standing idle for a short time, it would take a few strokes of the compressor to form a pressure and force the valves back on the seats, which shows that springs are not absolutely necessary. The Werkspoor type of compressor valves and cooling chambers are the best I have yet been with. The cooling chambers are specially designed cast iron boxes which do away with the leaky joints so often met with where coils are used. Their type of valve is of very simple design, requires no spring, is very cheap to renew, and is very durable. When one considers the amount of workmanship required to make some types of compressor-valves, the Werkspoor type of valves forms a great achievement.

Where the compressors are driven off levers attached to the engine the link brasses have a tendency to wear rather heavily, and the bearing surface should be of ample dimensions to overcome this. A large link bearing does not look very nice, but good looks do not help the good running of the engine, or the extra time required for adjustment in port. For this reason I prefer the type of piston that compresses one of the stages on the down stroke as it gives the link brasses a longer life. The same heavy wear also takes place on the gudgeon brasses, unless ample bearing surface is allowed. Where compressors are driven direct off the levers, without piston-rod or guide-bars, the cylinders wear oval, which can be expected, causing leakage of air past the piston springs. Where substantial piston-rods and guide-bars are fitted, the cylinders wear evenly and the heavy air leakage does not take place past the pistons.

Before concluding I should like to give a little information about the present engines of the motor-vessel "Sebastian" for the benefit of those who have formed a bad opinion of motor-driven vessels. In the first place these engines are built on the experience gained by Werkspoor on other ships which they have engined, and defects which occurred in some of the previous engines built by them have been overcome to such an extent that they have installed into this ship quite a reliable set of engines. These engines have brought the ship through some of the worst weather conditions the Atlantic can give, without any engine trouble whatever, and I must say that from years of experience with steam marine engines, give me the Diesel engines of this ship in preference to steam engines in heavy weather.

During the time the ship has been in commission the main bearings have worn down 1/128" The crank pin bearings, although opened out for examination at regular periods, have only been readjusted once in 10 months, the wearing showing 2/10 mm. The crosshead bearings have been readjusted to 3/10 mm. in the same period. Compressor piston rings are the same which came out with the ship, and show hardly any wear at all. There has been no cracked cylinder-heads, or cracked water-jackets, and no cracked-pistons. A few of the main piston-rings have been renewed; but this has been mostly due to breaking them when springing them off the pistons for cleaning purposes. The cooling-pump valves are as good as the day they were put in, some ten months ago.

Another point about the engines which will hardly be credited by some people, the engines had no shop trials. They were sent from Amsterdam to England in packing cases. Installed in the ship, and a short trial was made, which was very satisfactory, and the ship was sent off on her voyage.

If these remarks should meet the eye of any one who has a bad opinion of Diesel engines, the same bad opinion having been formed, and I know rightly so, with some of the earlier type of motors, these few remarks will go to show that the modern marine Diesel engines built by a good firm are quite as reliable and show no more wear and tear than a steam-engine.

FRISCO STANDARD BOOK OF BOATS.

We are in receipt of an advance copy of the Frisco Standard Book of Boats issued by the Standard Gas Engine Co. of San Francisco, manufacturers of the Frisco Standard engine. We predict that this wonderful compilation will more than accomplish any purpose aimed at from an advertising point of view, it being the most ambitious and certainly the most fascinating book of boats hitherto ever attempted.

The cover is handsomely decorated with a colored illustration of the motorship "Ruby," and within its 80 pages of profusely illustrated matter are twelve sections, each of which is devoted to a special type and design of vessel evolved to perform its separate and distinct part in the numerous maritime industries of the Pacific Coast and adjoining oceans. The value of this publication demands that it be recognized as a standard work in more sense than one, and the Standard Gas Engine Company, together with those who assisted, are to be highly complimented upon the production of the Frisco Standard Book of Boats.

3,000-TON DIESEL MOTORSHIP OF FERRO-CONCRETE.

There is due for delivery in July, the first large motorship of ferro-concrete construction, which now is on order for the Sydvaranger Mine company of Norway, and will be used for carrying iron-ore across the North Sea. She is of 3,000 tons and is being equipped with two direct-reversible Polar-Diesel engines each of 300 b. h. p. Her builders are the Fougner's Staalbeton Skilsbygnings Co., of Moss, Norway, who will build semi-concrete hulls up to 5,000 tons per ship.

ANOTHER STEAMER CONVERTED.

We recently mentioned that the Anglo-Saxon Petroleum Co. had purchased four large steamers from which the steam machinery is being removed and replaced with four-cycle type Diesel engines of Dutch design. We now learn that the Swedish coastwise steamer "Nya Sandhamm" had her machinery removed this past winter and replaced with a 250 b. h. p. Polar-Diesel two-cycle motor.

SWEDISH AUXILIARIES.

The Brodin Steamship Line of Sweden has ordered several three-masted motor-auxiliary schooners each of 800 tons d. w. c. They are building at the Gefle Yard and Works. The Ferrig Shipbuilding yard is building two 4,000 ton steel auxiliary-motor schooners. Each is 321 ft. long by 37½ ft. depth and 19 ft. moulded depth, and will be engaged in the transatlantic trade. In both ships two 240 b. h. p. Bolinder oil engines will be installed, and a speed of 8 knots is expected. The 580 ton motor auxiliary "West" has been delivered from the Kaldness Patentslip at Iredestrand. Her engine is a 120 h. p. Bolinder that drives her at 7 knots. She is 152 ft. long with 29 ft. breadth, and 19 ft. depth.

SPANISH GOVERNMENT ENCOURAGES DIESEL ENGINE CONSTRUCTION.

With a view to fostering the building of marine Diesel-type engines in Spain the Spanish government has invited tenders from domestic companies for eighteen marine Diesel engines, each of 400 b. h. p., for installation in small coastal defense craft. This will mean an outlay of about half-a-million dollars for the engines alone, without hulls, propeller gear, and auxiliary machinery.

The authorities also have hinted that if this offer meets proper support, they will give out orders for thirty-six Diesel engines of 600 b. h. p. to 1,000 b. h. p. for submarines. It is said that already the Sociedad Espanola de Construccione Metalicas has purchased a Sulzer-Diesel license.

MOTORSHIP COVERED 120,000 NAUTICAL MILES IN THREE YEARS.

Although built nearly five years ago, which was in the days when much remained to be learned regarding the construction and operation of marine Diesel-type engines, the Belgian motorship "Emmanuel Nobel" ran no fewer than 120,000 nautical miles up to June, 1915. No record since then is available, but had she not run fairly well during the first three years of her service she could not have covered 120,000 nautical miles. At present she is operated by the Sun company of Philadelphia, Pa.

DEAD-WEIGHT-CAPACITY.

Why This Term Has Become Obsolete.

So far as motorships are concerned the term "dead-weight-capacity" should be abolished, or as little used as possible, because it is entirely misleading, although its application is perfectly feasible with steamers when only steamers are under consideration. This is due to the fact that the dead-weight-capacity of a ship—whether steam or motor driven, includes among other things, coal or oil-fuel, bunkers, and boiler-water, which with steamers of given sizes have certain proportions familiar to all owners.

To follow our reasoning let us take as an example a steamship of 10,000 tons dead-weight-capacity. This dead-weight consists of:

1,300 tons fuel (sufficient round voyage N. Y. to Europe)
150 tons boiler water
50 tons drinking water
40 tons stores
3 tons crew
8,457 tons cargo

Total..10,000 tons

Now a Diesel-driven motorship of 10,000 tons dead-weight-capacity will be divided into the following:

400 tons fuel (sufficient round voyage N. Y. to Europe)
100 tons donkey boiler water (25 tons if chiefly electric auxiliaries)
50 tons drinking water
40 tons stores
3 tons crew
9,407 tons cargo

Total..10,000 tons

By which it will be seen that the motorship of the same dead-weight-capacity as the steamer carries 950 tons more cargo in her holds without taking into consideration an additional saving of 100 to 200 tons due to the lighter weight of machinery, caused by the absence of main boilers and their contents.

As a general rule shipowners when ordering new vessels, or buying or chartering existing vessels, figure out the cost as being "so much per ton d. w. c." How misleading this is at once becomes apparent by referring to the foregoing figures.

In the case of both vessels the d. w. c. is 10,000 tons, for which he pays, say, $1,100,000.00 per ship, or $110 per ton d. w. c. But, as the steamer's actual cargo capacity is only 8,547 tons, he really is paying over $123 per ton of cargo capacity.

Seeing that the motorship has a carrying capacity of 9,407 tons plus 150 tons, or a total of 9,557 tons the purchaser is paying only a little over $115 per ton of cargo capacity, although the d. w. c. is about the same.

It is most important for shipowners to bear in mind that a freight, or tank, ship is built to carry cargo, so that when figuring out the value of a ship the cost per ton of actual-cargo-capacity always should be made prominent. When this is done the wonderful economical value of the motorship will be appreciated.

Should the fuel-bunker figures not fully be understood it may be mentioned that the vast difference is due to the fact that the fuel consumption of a Diesel ship including auxiliaries at sea, should not exceed 0.3 lbs. per i. h. p. hour, whereas the average steamer will consume 0.1 lbs. of oil-fuel per i. h. p. hour, or 0.3 lbs. of coal per i. h. p. hour. We realized, of course, that these last two consumptions are sometimes bettered, and so is the foregoing motorship consumption, so matters are even in that respect.

In view of the fact that the term dead-weight-capacity has become obsolete for use when comparing motorships with steamers, shipowners always had best obtain the loaded displacement (actual weight in the water of the ship with cargo, etc.) and the weight of the actual cargo-capacity, then he will know immediately exactly for what he is paying when he buys a ship. The difference in tonnage between the dead-weight-capacity and the displacement, is, of course, accounted for by the hull, machinery, and equipment.

NAVAL ARCHITECT CHANGES ADDRESS.

Elliott N. Burwell announces that he has removed his offices from the Paddo Dock Building, 101 Tremont Street, to new and larger quarters at No. 156 State Street, Boston, Mass., Room 51.

NEW COMMAND.

Capt. S. E. McClements, for more than 20 years connected with the Robert Dollar Steamship Service, has accepted command of the McCormick auxiliary schooner "City of Portland," succeeding Captain Olaf Johnson.